5

Seasonal Distribution, Hosts, and Identification of Parasites of Cotton Insects

U.S. Department of Agriculture
Agricultural Research Service
Agricultural Reviews and Manuals•ARM-W-27/September 1982

A copy of this publication is available upon request from the Western Cotton Research Labortory, 4135 E. Broadway Road, Phoenix, AZ. 85040.

International Standard Serial Number (ISSN) 0193-3760

Agricultural Research Service, Agricultural Reviews and Manuals, Western Series, No. 27, September 1982

Published by Agricultural Research Service (Western Region), U.S. Department of Agriculture, Oakland, Calif. 94612

ABSTRACT

Insect flight traps were placed in cottonfields in two locations in Arizona during 1979 as well as in fields of alfalfa and corn. The species of Tachinidae and parasitic Hymenoptera were determined, as were their relative abundance during the season. The known hosts, distribution, and biology of individual species of Tachinidae and parasitic Hymenoptera are discussed, and a key is given for their identification.

KEYWORDS: Cotton, alfalfa, corn, Tachinidae, Braconidae, Ichneumonidae, Chalcididae, bollworm, tobacco budworm, cabbage looper, beet armyworm, saltmarsh caterpillar, flight trap.

CONTENTS

SEASONAL DISTRIBUTION, HOSTS, AND IDENTIFICATION OF PARASITES OF COTTON INSECTS

G. D. Butler, Jr., T. J. Henneberry, F. G. Werner, and J. M. Gillespie[1]

INTRODUCTION

The role of naturally occurring beneficial insects in regulating pest species below economic levels in crop systems has long been considered by entomologists as the single most important factor in minimizing many insect problems. This fact was not fully appreciated in cotton, *Gossypium* spp., production systems until the extensive use of insecticides in the Southeast, which was largely triggered by the occurrence of the boll weevil, *Anthonomus grandis* Boheman (Newsom and Brazzel *1968*).[2]

Numerous authors have since elucidated the importance of indigenous parasites and predators in regulating pest insect populations of cotton, as well as the adverse effect of insecticides in reducing numbers of these natural enemies (Newsom and Smith *1949*; Wille *1951*; Gaines *1942*, *1955a*, *1955b*; Ewing and Ivy *1943*; Van Steenwyk et al. *1975*; Van den Bosch et al. *1956*). The use of insecticides, however, has continued to increase until at present cotton production uses more insecticides than any other single crop (Andrilenas *1974*, *1975*). A recent assessment of the insecticide use problem in cotton production systems resulted in recommending the incorporation of several alternative control methods developed through research into an effective cotton pest management program (National Academy of Science *1975*). The selection and integration of such alternatives as host plant resistance, sex pheromones and attractants, biological control, genetic methods, cultural and physical methods, and selective pesticides should be considered as supplementary control measures. These should be utilized so that maximum benefits from the impact of indigenous parasites, predators and other natural control factors on the pest insect will be obtained.

---

[1]Research entomologists, Western Cotton Research Laboratory, Agricultural Research Service, Phoenix; professor of entomology, University of Arizona, Tucson; and research entomologist, Hercon Division of Health-Chem Corporation, Phoenix, respectively.

[2]The year in italic, when it follows the author's name, refers to Literature Cited, p. 43.

In the southwestern cotton-producing areas of Arizona and southern California, growers have relied heavily on insecticides for control of pink bollworm, *Pectinophora gossypiella* (Saunders), since 1967. Consequently, sporadic outbreaks of *Heliothis* spp. and cotton leafperforator, *Bucculatrix thurberiella* Busck, have occurred (Carruth and Moore *1973*) as a result of the destruction of parasites and predators. Several new technologies for pink bollworm control, such as mating inhibition (Shorey et al. *1976*), nectariless cotton (Wilson and Wilson *1976*), early termination of cotton fruiting by irrigation manipulation (Watson et al. *1978*) or plant growth regulators (Bariola et al. *1976*), and short season cotton systems (Walhood et al. *1981*), have the potential of significantly reducing the use of insecticides. With reduced insecticide use in cottonfields, the potential exists for developing an effective pest management system based on natural control principles supplemented by additional measures as needed.

BRIEF LITERATURE REVIEW

It is not within the scope of the present paper to review all of the literature regarding entomophagous insect studies in cotton production systems; however, the results of some selected studies that relate to Arizona and California growing areas follow.

Telford and Hopkins (*1957*), Wene et al. (*1965*), and Van den Bosch and Hagen (*1966*) reported green and brown lacewings (*Chrysopa* spp. and *Hemerobius* spp.), assassin bugs (*Sinea* spp. and *Zelus* spp.), damsel bugs (*Nabis* spp.), bigeyed bugs (*Geocoris* spp.) minute pirate bugs (*Orius* spp. and *Anthocoris* spp.), lady beetles, six-spotted thrips (*Scolothrips sexmaculatus* (Pergande)), striped collops (*Collops vittatus* (Say)), and syrphid flies as commonly found predators in Arizona and southern California cottonfields, as were a number of other miscellaneous insect predators and spiders. The Arizona authors mentioned that many species of parasites are also found.

Van den Bosch and Hagen (*1966*) listed a number of parasitic species of the beet armyworm, *Spodoptera exigua* (Hübner); cabbage looper, *Trichoplusia ni* (Hübner); bollworm, *Heliothis zea* (Boddie); cotton leafperforator, *Bucculatrix thurberiella* Busck; saltmarsh caterpillar, *Estigmene acrea* (Drury); and the western yellowstriped armyworm, *Spodoptera praefica* (Grote).

In a 3-year study in Arizona, Wene and Sheets (*1962*) found that numbers of *Geocoris* spp., *Orius* spp., *Collops vittatus*, *Nabis* spp., and lady beetles, mostly *Hippodamia convergens* Guérin-Ménevile, were more abundant in cottonfields in June and July than in August. Numbers of *Chrysopa* spp. were highest in August as compared with those found in June and July. The authors indicated that the predator complex was not effective in reducing *Lygus* spp. or preventing development of destructive levels of saltmarsh caterpillar, cotton leafperforator, or cabbage looper. *Orius* and *Chrysopa* spp. were observed feeding on bollworm eggs and larvae and did prevent populations from reaching destructive levels.

Clancy (*1946*) reported that *Collops marginellus* LeConte consumed about 19 percent of the eggs of the western brown stink bug, *Euschistus impictiventris* Stål, while *Trissolcus utahensis* (Ashmead) parasitized an additional 43 percent in Arizona cottonfields. The author also reported 80 percent parasitism (*Closterocerus utahensis* Crawford) of cotton leafperforator larvae collected in September and October, but only 7.2, 4, 3.3, and 0.2 percent parasitism by *Catolaccus aeneoviridis* (Girault), *Spilochalcis* side (Walker), *Haltichella* sp., and *Hormes* spp., respectively, of cotton leafperforator cocoons collected July through September.

Tuttle et al. (*1961*) observed *Orius* spp. nymphs, *Chrysopa* spp. larvae, and adult *Collops* and *Hippodamia* feeding on cotton leafperforator larvae in the field. Thus, published reports indicate that indigenous parasites and predators have significant impact on regulating pest insects in cotton production systems in the southwestern United States.

Quantification of the impact of these beneficial insects as a group or as individuals is difficult because of the many species involved and the biological interactions within and between the beneficial species, as well as with their host pest insects and host plants. The first step toward an understanding of these relationships is the development of information regarding the seasonal occurrence, abundance, and identification of beneficial insects present in cropping systems. Thus, studies were conducted in 1979 to obtain information on insect parasites commonly occurring in cotton, alfalfa, and corn in Arizona. The present report is a result of these studies, as well as information on the geographical distribution of parasites in various crop habitats in Arizona from earlier studies by Butler and Werner between 1954 and 1956 (unpublished data).

METHODS AND MATERIALS

One insect flight trap, modified from Butler (*1966a*), was installed at Rainbow Valley, Ariz., 30 km southwest of Phoenix, in each of four cottonfields treated with gossyplure[3] plus TF, four fields treated with gossyplure plus virelure, four fields treated with gossyplure plus Z9TF, and four fields treated with insecticides under pest control advisor supervision. All fields were treated with methidathion on June 27; sulfur on July 17, August 10, and August 24; and permethrin plus chlordimeform on August 31. Insects were collected in the traps one or two times per week from June 14 to October 10, 1979.

At the University of Arizona Cotton Research Center, Phoenix, similar traps were installed and operated from May 11 to September 25, 1979, in two untreated cottonfields and two insecticide-treated cottonfields. Fields were treated with carbaryl on July 22, 28, and August 3; permethrin on August 9; fenvalerate on August 15, 21, 28, and September 3 and 10; and carbaryl on September 17 and 25.

Two 2-m flight traps were operated at the Cotton Research Center in alfalfa from May 15 until September 12, and then four 4-m traps were operated until May 1980. Two 2-m traps were operated in corn in Tempe from June 6 to July 31, 1979.

---

[3]Chemical names are given on the last page of this publication.

All parasites were identified in the laboratory of Floyd G. Werner, University of Arizona, Tucson.

The information regarding geographical distribution and abundance of Tachinidae and parasitic Hymenoptera in Arizona was obtained during a series of extensive sampling programs to determine insect fauna in various cultivated crop areas from 1954 to 1956. Details of the sampling procedures used in these studies were discussed by Butler and Werner (*1957*). From these studies, the relative abundance of the Tachinidae was estimated from samples of about 4,400 specimens and the abundance of the parasitic Hymenoptera (Braconidae, Ichneumonidae, and two species of Chalcididae) from about 5,000 specimens in the insect collection at the University of Arizona. Information on hosts and U.S. distribution of the Diptera was obtained from Stone et al. (*1965*) and Arnaud (*1978*) and for the Hymenoptera from Krombein et al. (*1979*). The keys and the figures associated with the keys are modified from Werner (*1978*). Numerous species of small chalcidoid parasites are present in cottonfields but were not collected in the flight traps and are not included in this report.

RESULTS

Rainbow Valley, Ariz.

Cotton

Flight traps caught 2,713 tachinid flies and 397 parasitic hymenopteran specimens, consisting of Braconidae, Ichneumonidae, and Chalcididae in cottonfields. Sixteen identified and at least one unidentified species of tachinid flies were collected from the flight traps. The most abundant lepidopterous parasites (listed in appendix table 1) were *Eucelatoria* spp., *Voria ruralis* (Fallén), and *Lespesia archippivora* (Riley). *Eucelatoria* and *Lespesia* have often been reported parasitizing *Heliothis* spp., and *Chaetogaedia*, *Nemorilla*, and *Euphorocera* are also known to parasitize *Heliothis* spp. (Werner and Butler *1979*). *Voria* is most often reported parasitizing cabbage loopers. *Eucelatoria* reached peak numbers during mid- to late August. *Lespesia* was most abundant early in the season, whereas the highest numbers of *Voria* were recorded in late September and October. From September 20 to October 10, an average of 4.6 flies were caught per trap per day.

Other identified tachinid parasites recorded were *Leucostoma simplex* (Fallén), *L. aterrimum* (Villers), and *Paradidyma*, *Ceratomyiella*, *Hyalomya*, *Gymnosoma*, *Periscepsia*, *Frontiniella*, *Cylindromyia*, and *Erynnia* species.

Six species of Braconidae were also collected. *Chelonus insularis* Cresson was the most abundant, occurring in late June and increasing in numbers in late August and early September. Similarly, *Microplitis* spp. were also highest during late August to early September. *Chelonus cautus* Cresson, *Zele mellea* (Cresson), and *Zelomorpha arizonensis* Ashmead occurred in highest numbers in mid- to late June and decreased thereafter. *Cardiocheles* spp. occurred only in one collection in early August. Five identified species and one unidentified species of Ichneumonidae were recorded. The highest numbers were *Anomalon* spp., whereas *Diplazon*, *Hyposoter*, *Pristomerus*, and *Temelucha* species were collected in low numbers.

Of the two species of Chalcididae, *Brachymeria ovata* (Say) was the more abundant. The highest numbers were caught in late July through late August. *Spilochalcis* spp. occurred in highest numbers through late July.

Pheromone applications did not have an effect on numbers of any of the parasite species collected prior to the first insecticide application of permethrin on August 31. Most parasite species had already declined to low numbers at that time. September populations of *Voria ruralis* and *Chelonus insularis*, however, were observed only in fields not receiving insecticide treatments in late August or September.

University of Arizona Cotton Research Center, Phoenix

Cotton

Flight traps caught 3,048 tachinid flies and 556 hymenopterous parasites (including Braconidae, Ichneumonidae, and Chalcididae). Eighteen identified and at least one unidentified species of tachinids were collected in both insecticide treated and untreated cottonfields. The six species caught in highest numbers are listed in appendix table 2. Other identified tachinids caught were *Paradidyma*, *Ceratomyiella*, *Mericia*, *Chaetogaedia*, *Gymnosoma*, *Periscepsia*, *Nemorilla*, *Micromintho*, *Cylindromyia*, *Archytas*, *Athyricia*, and *Frontiniella* species. *Lespesia archippivora*, *Voria ruralis*, *Eucelatoria* spp., and *Euphorocera tachinomoides* Townsend were most abundant. Seven identified and at least one unidentified species of Braconidae were also collected, but the only species occurring consistently throughout the season was *Chelonus insularis*. Other identified braconids caught were *Macrocentrus*, *Meteorus*, *Microchelonus*, *Microplitis*, *Zele*, and *Zelomorpha* species. Highest numbers of braconids were recorded in late June.

Six ichneumonid species (*Anomalon*, *Diplazon*, *Hyposoter*, *Netelia*, *Pristomerus*, and *Compsocryptus* species) were collected in low numbers. Of the two identified chalcidid species, *Brachymeria ovata* was more abundant with high numbers recorded in early August and again in late September. *Spilochalcis* spp. were also collected in high numbers in mid-July, declining thereafter.

Alfalfa

Flight traps caught 2,101 tachinid flies and 2,897 parasitic Hymenoptera. During mid-May to mid-September, 18 identified species of tachinids were collected. The nine most abundant species are listed in appendix table 3. Other tachinids collected were *Leucostoma simplex*, *L. aterrimum*, and *Mericia*, *Nemorilla*, *Micromintho*, *Cylindromyia*, *Archytas*, *Frontiniella*, and *Hyphantrophaga* species. *L. archippivora* was by far the most abundant with population peaks recorded in mid-May and again in August although it was present throughout the summer. *Voria ruralis* was the next most abundant tachinid with the highest observed populations in May. *Eucelatoria* spp. were present throughout the summer but were more abundant in October and November, as shown in samples not included in appendix table 3.

Seven species of Braconidae (*Chelonus*, *Microchelonus*, *Zelomorpha*, *Zele*, *Apanteles*, *Cremnops*, and *Macrocentrus* species) were collected and identified from the flight trap. Only *Chelonus texanus* was present in relatively large numbers and was found throughout the season. One braconid was unidentified. *Zele mellea* was present only in May and June. Of the chalcidids, *Brachymeria* was most abundant, although *Spilochalcis* spp. were collected occasionally.

Eight species of Ichneumonidae were collected but only in low numbers. One species was unidentified. *Pristomerus* spp. were most abundant. Other species collected were *Anomalon*, *Diplazon*, *Hyposoter*, *Temelucha*, *Diadegma*, *Compsocrytus*, and *Netelia* species.

Tempe, Ariz.

Corn

Flight traps caught 683 tachinid flies and 206 parasitic Hymenoptera. Sixteen species of tachinids were collected. The most abundant species was *Micromintho melania* Townsend followed by *Ceratomyiella bicincta* Reinhard and *Periscepsia laevigata* (Wulp) (appendix table 4). *Lespesia archippivora*, *Eucelatoria* spp., and *Voria ruralis* were present but in smaller numbers. *Archytas*, *Chaetogaedia*, *Cylindromyia*, *Gymnosoma*, *Mericia*, *Leucostoma*, *Paradidyma*, and *Euphorocera* species were also collected. *Compsocryptus calipterus* (Say) was the most abundant hymenopteran species trapped. Also collected were *Chelonus*, *Zele*, *Zelomorpha*, *Anomalon*, *Hyposoter*, *Netelia*, *Pristomerus*, *Temelucha*, *Brachymeria*, and *Spilochalcis* species.

DISCUSSION

The role of indigenous and introduced natural enemies of insect pests in cultivated agroecosystems has long been recognized as a basic component of integrated pest management systems. A key pest in Arizona and southern California cotton ecosystems is the pink bollworm. This species was introduced into the United States in Texas in 1917 from Mexico. It moved westerly slowly and has been firmly established in Arizona and California as a cotton pest species since about 1965. Scheduled applications of insecticides are the current principal method of control, which has frustrated progress in the development of an integrated pest management system for cotton insect control.

The pink bollworm was thought to be a native of India; however, recent studies place its origins in the eastern Indian Ocean bordered on the east by northwestern Australia and on the west by various islands of the Indonesia-Malaysia area (Common *1958*, Wilson *1972*). Efforts to permanently establish 11 species of parasitic Hymenoptera, successfully reared from pink bollworms obtained during foreign explorations in India, eastern Africa, southern Europe, Australia, and Hawaii, have failed (Legner and Medved *1979*). Similar results were obtained with imported parasites in Texas from 1932 to 1955 (McGough and Noble *1957*) and in Arizona from 1971 to 1974 (Bryan et al. *1973*, *1976*; Fye and Jackson *1973*). A search for additional natural enemies, as proposed by Legner and Medved (*1979*), in the now presumed Australasian native range of the pink bollworm, may yield effective natural enemies.

The results of the present studies revealed a number of known tachinid and hymenopterous parasites of lepidopterous and other pests of cotton. The effectiveness of these parasites and their impact on regulating populations is not well quantified but is increasingly recognized as substantial throughout the agricultural industry. Attempts to implement various nonchemical control alternatives to the sole reliance on insecticide control of cotton pest insects have expanded in recent years and are gaining grower acceptance. As these alternative strategies are adopted, it will be possible to conduct research to quantify and optimize control of this natural pest enemy complex.

HOSTS, GEOGRAPHICAL DISTRIBUTION IN THE UNITED STATES (PARTICULARLY ARIZONA), AND SELECTED BIOLOGY

Tachinidae

Alophorella aeneoventris **(Williston)**

HOST: HEMIPTERA Miridae (Adult)
Lygus hesperus Knight probably
Lygus lineolaris (Palisot de Beauvois)
Reared from several other hosts in eastern United States.

DISTRIBUTION: Widely distributed in United States. From high in the Santa Catalina Mountains, Ariz., 11 specimens were collected. Some have been reported in the Tucson area in sweep collections from alfalfa.

Archytas apicifer **(Walker)**

HOST: LEPIDOPTERA (Larva, pupa)
Lasiocampidae
Malacosoma californicum (Packard), western tent caterpillar
Noctuidae
Peridroma saucia (Hübner), variegated cutworm
Pseudaletia unipuncta (Haworth), armyworm
Spodoptera frugiperda (J. E. Smith), fall armyworm

DISTRIBUTION: Widely distributed across the United States. In Arizona, 110 specimens were collected in the lowlands. They were most abundant in cotton and alfalfa in June and July. At Phoenix, 29, 30, and 40 specimens were collected in cotton, alfalfa, and corn, respectively. They were collected in all months of the year except January, March, and September.

Archytas lateralis **(Macquart)**

HOST: LEPIDOPTERA (Larva, pupa)
Lasiocampidae
Malacosoma californicum fragile (Stretch)
Malacosoma incurvum (Henry Edwards), southwestern tent caterpillar

DISTRIBUTION: Florida, Montana, Wyoming, and California. Many of the 380 Arizona specimens were reared from tent caterpillars collected in the southeastern canyons and at Tucson.

Archytas marmoratus (Townsend)

HOST: LEPIDOPTERA (Larva, pupa)
Noctuidae
Heliothis zea (Boddie); bollworm, corn earworm, tomato fruitworm
Pseudaletia unipuncta (Haworth), armyworm
Spodoptera frugiperda (J. E. Smith), fall armyworm

DISTRIBUTION: Widely distributed across the southern United States. Only 10 specimens were collected in the Tucson area and Madera Canyon. Rare in traps in cotton and alfalfa; six specimens were caught in corn.

Athrycia cinerea (Coquillett)

HOST: LEPIDOPTERA
Noctuidae
Pseudaletia unipuncta (Haworth), armyworm

DISTRIBUTION: Texas, New Mexico, Colorado, Arizona, and California. Adults have been collected in the southern half of Arizona with a single record from Navajo County. The species is most abundant during June and July.

Bonnetia comta (Fallén)

HOST: LEPIDOPTERA (Larva, pupa)
Noctuidae
Numerous cutworm and armyworm rearing records.

DISTRIBUTION: Widespread throughout the United States and Canada. In Arizona, 15 specimens were collected in Fredonia, in the Tucson area, and in southeastern canyons but not in crops or traps.

Ceratomyiella bicincta Reinhard

HOST: Unknown.

DISTRIBUTION: Alaska to California, south to Mexico. In Arizona, 45 specimens were collected in lowlands with only 1 in crops. In Rainbow Valley, 8 specimens were collected in flight traps in cotton, but 161 were collected in Phoenix cotton from May to September, with July and August having the largest collections. In alfalfa, 62 specimens were collected, mostly in July and August. This species was abundant in corn with 125 specimens caught.

Chaetogaedia spp.

HOST: LEPIDOPTERA (Larva, pupa)
Noctuidae
Autographa californica (Speyer), alfalfa looper
Heliothis virescens (Fabricius), tobacco budworm
Spodoptera exigua (Hübner), beet armyworm
Nymphalidae
Vanessa cardui (L.), painted lady
Numerous other hosts in Hawaii.

DISTRIBUTION: About 150 specimens of the two species (*C. monticola* (Bigot) and *C. desertorum* (Townsend)) of this genus were collected in the lowlands of southeastern Arizona to the southeastern mountains with about 20 in crops. Only four specimens were collected in the Rainbow Valley flight traps in cotton. In Phoenix cotton, 69 specimens were collected in May, June, and July. In alfalfa, 47 specimens were collected from April to August, but mostly in May. In corn, 14 specimens were collected.

Chaetonodexodes vanderwulpi (Townsend)

HOST: COLEOPTERA (Larva)
Chrysomelidae
Monoxia consputa (LeConte)

DISTRIBUTION: Florida to California and Colorado. In Arizona, 15 specimens were collected in the lowland areas as well as in Sedona and Chinle. In 1978, 17 specimens were collected in cotton.

Cylindromyia spp.

HOST: HEMIPTERA (Adult)
Pentatomidae
Chlorochroa ligata (Say), conchuela
Chlorochroa sayi Stål, Say stink bug

DISTRIBUTION: Widely distributed across the United States. In Arizona, 100 specimens of several species of *Cylindromyia* were collected, mostly in canyon areas of southeastern Arizona. In cotton, only 5 specimens were collected in Rainbow Valley and 10 in Phoenix cotton. Traps in alfalfa collected 24, with 13 specimens in November. Four specimens were caught in corn.

Deopalpus spp.

HOST: Unknown

DISTRIBUTION: A total of 45 specimens were collected from southeastern canyons north to Flagstaff. None were taken in crops.

Drino spp. (four species)

HOST: Lepidoptera including many forest defoliators and sphinx moths. (Larva pupa)

DISTRIBUTION: In Arizona, about 130 specimens were collected in the southeastern lowlands.

Eucelatoria armigera (Coquillett)

HOST: LEPIDOPTERA (Larva, pupa)
Arnaud (*1978*) lists numerous hosts in six families with the majority of the records from Hawaii and Cuba.
Records from Arizona need re-examination.
Noctuidae
Heliothis virescens (Fabricius), tobacco budworm
Heliothis zea (Boddie); bollworm, corn earworm, tomato fruitworm
Spodoptera exigua (Hübner), beet armyworm
Trichoplusia ni (Hübner), cabbage looper

DISTRIBUTION: This appears to be the abundant species of *Eucelatoria* in these flight trap collections. *Eucelatoria bryani* was not differentiated from *E. armigera* while the study was in progress but approximately 720 of 785 specimens retained belong to armigera. Specimens of *Eucelatoria* were generally present in trap samples in cotton from May through September with a definite peak of abundance in early August in both 1978 and 1979. This was the second most abundant genus in Rainbow Valley cotton with 732 specimens; Phoenix cotton had 598. In alfalfa, 211 flies were collected from April to December with 79 in October and 78 in November. Adult activity at this time of year could have a significant effect on the overwintering generation of *Heliothis*. Only nine were collected in corn.

BIOLOGY: Under laboratory conditions, adults mate soon after emergence (Jackson et al. *1969b*) and females larviposit in about 5 days. The female stands on the host larva, drives her larvipositor through the body wall, and deposits as many as 20 larvae into the body cavity. Three larval stages develop within the host larva in about 3.8 to 12.7 days at temperatures ranging from 30° to 15°C. Larvae consume the entire caterpillar except the cuticle before emerging to pupate. The pupal period is about 5.6 to 23.7 days at the same temperature range (Bryan et al. *1970*).

Adults are 4 to 8 mm in length. They are grayish black and characteristically have a reddish tinge to the tip of the abdomen. Females have a dagger-like, forward directed larvipositor. Puparia have three light-colored lines in the dark occluded spiracular plate.

Eucelatoria bryani Sabrosky

HOST: LEPIDOPTERA (Larva, pupa)
Noctuidae
Heliothis virescens (Fabricius), tobacco budworm

Heliothis zea (Boddie); bollworm, corn earworm, tomato fruitworm
Spodoptera frugiperda (J. E. Smith), fall armyworm

This list is from Sabrosky (*1981*), who includes also another noctuid, *Anticarsia gemmatilis* Hübner, the velvetbean caterpillar, but no other genera.

DISTRIBUTION: A high percentage of the specimens of *Eucelatoria* collected or reared from the southeastern counties of Arizona (Pima, Santa Cruz, Cochise, Graham, and Greenlee) are identifiable as this species by the criteria given by Sabrosky (*1981*). Only 66 of approximately 785 specimens retained from the flight trap collections in central and western Arizona belong to it. A comparatively low percentage of the 350 specimens from the southeastern counties in the University of Arizona collection are assignable to *Eucelatoria armigera*. Since most of the southeastern specimens were collected or reared before 1960, there may have been a temporal change in fauna rather than the geographic difference that is obvious. Sabrosky (*1981*) cites locations from Arizona to Arkansas and Mississippi, and from there south to Nicaragua.

BIOLOGY: Jackson et al. (*1969a*) reporting this species in error as *Eucelatoria armigera*, found that it was essentially limited to *Heliothis* spp., with rare instances of parasitization of *Trichoplusia ni* (Hübner), the cabbage looper. Since Sabrosky (*1981*) does not list *Trichoplusia* among the known hosts, he probably did not verify the identification of any specimens reared from this host at the Tucson laboratory. Bryan et al. (*1970*) compared it (as *Eucelatoria* sp.) with *Eucelatoria armigera* from Hawaii, in a laboratory study. The behavior of the adults was essentially the same, except for the sharp contrast in breadth of host selection, and developmental times were slightly longer. The larval stages took 3.8 to 14.2 days at 30° to 15°C and the pupal stage from 7.3 to 32.4 days at the same temperature range. In a separate study (Bryan et al. *1972*), the average number of progeny produced per female was found to range from 68 at 20° to 113 at 30°C. The average longevity of females and males ranged from 62 to 18 days and from 53 to 11 days, respectively, at temperatures from 20° to 35°C.

***Euphorocera tachinomoides* Townsend**

HOST: LEPIDOPTERA (Larva, pupa)
Hesperiidae
Lerodea eufala (Edwards), rice leaffolder
Lasiocampidae
Malacosoma incurvum (Henry Edwards), southwestern tent caterpillar
Noctuidae
Heliothis zea (Boddie); bollworm, corn earworm, tomato fruitworm
Spodoptera ornithogalli (Guenée), yellowstriped armyworm
Pieridae
Artogeia rapae (L.), imported cabbageworm

DISTRIBUTION: California to South Dakota south to Texas. More than 500 specimens in the Arizona collections came from the lowlands, mostly reared from tent caterpillars, with a few collected from crops. Flies were reared from a green looper on acacia. In Rainbow Valley cotton, 83 flies were caught in traps and at

Phoenix, 191 flies were collected mostly during June and July. Traps in alfalfa collected 58 flies and in corn 10. Many of the flies taken in flight traps were very small relative to flies reared from hosts.

Exorista mella **(Walker)**

HOST: LEPIDOPTERA (Larva, pupa)
Arctiidae
Estigmene acrea (Drury), saltmarsh caterpillar
Danaidae
Danaus plexippus (L.), monarch butterfly
Lasiocampidae
Malacosoma incurvum (Henry Edwards), southwestern tent caterpillar
Saturniidae
Hemileuca oliviae Cockerell, buck moth

DISTRIBUTION: All the United States. The 120 Arizona specimens were collected mostly in the lowlands to Flagstaff. Some were reared from tent caterpillars, and about 20 were in crops. A few were collected in flight traps in cotton but none in 1979. Generally, the species is rare in crop areas except in association with saltmarsh caterpillar outbreaks or perhaps with tent caterpillars.

BIOLOGY: The fly is slender, grayish black, and varies in length from 7 to 13 mm (Taylor *1954*). From one to four individuals have been reared from a single host. Females lay white, oblong eggs (about 1 mm long, 0.5 mm wide) on host larvae while facing the host and drawing the tip of the abdomen forward between the front legs. Larvae are the preferred hosts. As many as 20 to 25 eggs have been found on a single saltmarsh caterpillar larva. A single female may lay as many as 100 eggs (Townsend *1908*).

The duration of the egg stage varied from slightly over 4 days at 20°C to 2 days at 30° (Butler et al. *1968*). Combined egg and larval development averaged 28.1 days at 15° and 7.9 days at 30°. Duration of the pupal stage was 27.4 days at 15° and 7.8 days at 30°. Of the fly larvae, 39 percent emerged from the host larvae, 20 percent from the prepupae, 26 percent from the pupae, and 15 percent remained in the host larvae. As many as seven parasitic larvae have been observed to emerge from a single host larva but about 60 percent of the host larvae contained only one parasite.

Frontiniella parancilla **Townsend**

HOST: LEPIDOPTERA (Larva, pupa)
Gelechiidae: *Gnorimoschema* sp.
Pyralidae: *Tetralopha scortealis* (Lederer), lespedeza webworm

DISTRIBUTION: Michigan to Connecticut, south to California and Florida. In Arizona, 50 specimens were collected in the southeast lowlands with 1 in crops and 10 swept from mesquite.

Gonia (two species collected in Arizona)

HOST: LEPIDOPTERA (Larva, pupa)
A wide range of cutworm and armyworm rearing records.

DISTRIBUTION: Widely distributed throughout United States. In Arizona, 110 specimens were collected mainly in Phoenix and Yuma (12 in crops) with a few in southeastern canyons, Oak Creek, and the White Mountains. A single specimen was taken in a trap in cotton in 1979.

Gymnosoma fuliginosum Robineau-Desvoidy

HOST: HEMIPTERA (Nymph, adult)
Pentatomidae
Chlorochroa ligata (Say), conchuela
Chlorochroa sayi Stål, Say stink bug
Euschistus impictiventris Stål, western brown stink bug

DISTRIBUTION: Widely distributed across the United States. In Arizona, 130 specimens were collected, some up to 8,000 ft elevation from Flagstaff and the southern mountains. In traps, a few specimens were collected in May, June, and July 1979 in cotton but none in August or September, although a few were collected in September in 1978. In Rainbow Valley, 20 and in Phoenix, 31 flies were caught in cotton, mostly in June. From March to August, 34 flies were caught in alfalfa, 11 in corn.

Hyphantrophaga hyphantriae (Townsend)

HOST: LEPIDOPTERA (Larva, pupa)
Lasiocampidae
Malacosoma incurvum (Henry Edwards), southwestern tent caterpillar
Noctuidae
Heliothis zea (Boddie), bollworm, corn earworm, tomato fruitworm
Pyralidae
Achyra rantalis (Guenée)

DISTRIBUTION: Michigan, Ohio to North Carolina and Florida. In Arizona, 20 specimens were collected in the southeastern lowlands with 5 on crops and 9 reared from tent caterpillars. A single specimen was collected in a trap in alfalfa in 1979.

Leschenaultia adusta (Loew)

HOST: LEPIDOPTERA (Larva, pupa)
Arctiidae
Estigmene acrea (Drury), saltmarsh caterpillar
Lasiocampidae
Malacosoma californicum (Packard), western tent caterpillar

DISTRIBUTION: New England and southwestern United States. About 15 specimens were collected in the Phoenix and Tucson areas, mostly reared from saltmarsh caterpillar. None were collected in flight traps.

BIOLOGY: This is a large robust fly, 7 to 14 mm long (Taylor *1954*). The female lays several thousand eggs on plant foliage in association with the host larvae. Host larvae feed on foliage and ingest the eggs. For the first few days after ingesting the eggs, host larvae appear to feed and behave normally, but gradually feeding slows as parasites develop. Development of egg and larval stages ranged from 9 to 10 days at 30°C to 27 to 28 days at 15°. The pupal stage ranged from 18 to 19 days at 30° to 55 to 61 days at 15°. Average longevity of females ranged from 49 days at 15° to 12 days at 35° (Jackson et al. *1970*).

Lespesia archippivora (Riley)

HOST: LEPIDOPTERA (Larva, pupa)
- Arctiidae
  - *Estigmene acrea* (Drury), saltmarsh caterpillar
- Danaidae
  - *Danaus plexippus* (L.), monarch butterfly
- Lasiocampidae
  - *Malacosoma incurvum* (Henry Edwards), southwestern tent caterpillar
- Noctuidae
  - *Agrotis ipsilon* (Hufnagel), black cutworm
  - *Heliothis zea* (Boddie); bollworm, corn earworm, tomato fruitworm
  - *Pseudaletia unipuncta* (Haworth), armyworm
  - *Spodoptera exigua* (Hübner), beet armyworm
  - *Spodoptera frugiperda* (J. E. Smith), fall armyworm
  - *Spodoptera ornithogalli* (Guenée), yellowstriped armyworm
  - *Trichoplusia ni* (Hübner), cabbage looper
- Nymphalidae
  - *Nymphalis antiopa* (L.), mourningcloak butterfly
  - *Vanessa cardui* (L.), painted lady
- Pieridae
  - *Colias eurytheme* Boisduval, alfalfa caterpillar
  - *Artogeia rapae* (L.), imported cabbageworm
- Pyralidae
  - *Loxostege commixtalis* (Walker), alfalfa webworm
  - *Achyra rantalis* (Guenée)
  - *Loxostege sticticalis* (L.), beet webworm

DISTRIBUTION: Widely distributed throughout the United States. In Arizona, over 1,000 specimens were collected, almost all from lowlands with the highest location at Dewey (4,556 ft). In Rainbow Valley traps in cotton, 93 flies were collected. At Phoenix, the species was the most abundant tachinid with 1,078 taken in cotton and 1,019 taken in alfalfa. In alfalfa, flies occurred in all months except February. Populations were large in late fall with 138 in October, 318 in November, and 195 in December. The species was also relatively abundant in corn with 68 specimens collected.

BIOLOGY: Adults are small (4 to 8 mm long), gray, active flies. They mate soon after emergence and at 25°C females have a preoviposition period of 2 to 5 days (Bryan et al. *1968*). Females stand on the host larvae, extend their ovipositor down, and place eggs on the surface of the host. Several eggs may be laid on one host and as many as 17 of the parasites have been observed to emerge from a

single host. At 25.6° to 26.7°, eggs hatch within 20 min, and the larvae enter the host through the body wall. There are three larval stages. Duration of the stages varies in different hosts. Total development time in the beet armyworm and cabbage looper is 44 to 45 days at 15° and 11 to 12 days at 30°. Development time in the bollworm and saltmarsh caterpillar is 47 to 57 days at 15° and 14 days at 30°. Fly larvae usually leave the host before pupating.

The reproduction and lifespan of the female parasites were studied in the laboratory by Bryan et al. (*1969a*). The largest number of offspring (425) was obtained from a single female held at 30°C; the means of total production ranged from 113 at 15° to 225 at 25°. When reproductive activity was measured as the mean number of puparia produced per oviposition day, activity appeared to peak (15.9) at 30°. Mean female longevity ranged from 40 to 53 days at 15° to 12 to 16 days at 35°, depending on the length of the daily oviposition period (4 or 6.5 hr). Most ovipositon occurred during the first 15 days of adult life. Bryan et al. (*1969b*) discuss the details of rearing this species in the laboratory.

Leucostoma aterrimum (Villers)

HOST: HEMIPTERA (Nymph, adult)
Rhopalidae
Liorhyssus hyalinus (Fabricius), hyaline grass bug

DISTRIBUTION: California to Wyoming and Kansas south to Texas. The 10 Arizona specimens are from the southeastern mountains and lowlands, with none collected on crops. Records from flight traps were merged with those of *L. simplex*.

Leucostoma simplex (Fallén)

HOST: HEMIPTERA (Nymph, adult)
Nabidae
Nabis alternatus Parshley, western damsel bug
Nabis americoferus Carayon, common damsel bug
Rhopalidae
Liorhyssus hyalinus (Fabricius), hyaline grass bug

DISTRIBUTION: Widely distributed in the United States. In Arizona, 140 specimens were collected in the lowlands, mainly in crops. The species was abundant in Rainbow Valley cotton with 545 specimens collected. In Phoenix, 150 flies were collected in cotton, mostly in June and July, and 256 in alfalfa, mostly in July. Traps in corn collected 56 flies.

Mericia aldrichi (Townsend)

HOST: HEMIPTERA (Adult)
Lygaeidae
Geocoris punctipes (Say), bigeyed bug
Nysius raphanus Howard, false chinch bug

DISTRIBUTION: Widely distributed across the United States. Of 240 Arizona specimens, almost all were collected from crops and in the lowlands, with a few high in the Santa Catalina Mountains. Only 4 were collected in Rainbow Valley cotton and 84 in Phoenix cotton; 5 were caught in alfalfa and 2 in corn. Of the total taken in traps, all but one specimen were taken in May. High populations seem to tie in with growth of London rocket, *Sisymbrium irio* L., during wet winters, and resultant high numbers of false chinch bugs.

Micromintho melania Townsend

HOST: Unknown.

DISTRIBUTION: Only three specimens were collected in the survey. In 1978, 22 specimens were collected in the traps in cotton. In cotton, in 1979, none were collected in Rainbow Valley, but 11 were taken in Phoenix. Only four were collected in alfalfa between May and August. It was the most abundant tachinid fly taken in corn with 172 specimens recorded.

Nemorilla pyste (Walker)

HOST: LEPIDOPTERA (Larva, pupa)
Wide host range of Lepidoptera.

DISTRIBUTION: Mainly found in eastern United States. In Arizona, 250 specimens were collected from the southeastern lowlands to Prescott, southeastern mountains, and some as far west as the Kofa Mountains. About 40 specimens were collected in crops. In 1979, eight were collected in Rainbow Valley traps in cotton and six in Phoenix during May and June. Only four flies were collected in alfalfa and none in corn.

Olenochaeta kansensis Townsend

HOST: Unknown.

DISTRIBUTION: Kansas to Ohio and Maryland, south to California and Florida. In Arizona, 130 specimens were collected in the lowlands, mostly in the southeast, but a few were in the White Mountains. Approximately half of the total were collected in crops.

Paradidyma obliqua Reinhard

HOST: Unknown.

DISTRIBUTION: Washington and Idaho south to California and Texas. In Arizona, six specimens were collected from the southeastern lowlands and three from crops.

Paradidyma singularis (Townsend)

HOST: LEPIDOPTERA

DISTRIBUTION: Montana to Maine, south to California and Florida. In Arizona, 50 specimens were collected from the southeastern lowlands to the White Mountains. Of these, 22 were taken in crops. In the flight traps, 58 were collected in Rainbow Valley cotton, 81 in Phoenix cotton, and 48 in alfalfa in May and June. During early June, 52 were collected from corn.

Periscepsia laevigata (Wulp)

HOST: LEPIDOPTERA (Larva)
Noctuidae
Euxoa auxiliaris (Grote), army cutworm
Peridroma saucia (Hübner), variegated cutworm
Pseudaletia unipuncta (Haworth), armyworm

DISTRIBUTION: Canada to Guatemala. Nine Arizona specimens were collected from Oak Creek, Tucson, and the southeastern mountains. Five flies were reared from a caterpillar (probably Noctuidae) collected in May at Tucson. Only 1 specimen was collected in Rainbow Valley cotton, but 12 were collected in May and June in Phoenix cotton. In alfalfa, all but 2 of the 29 taken were collected in May. Traps in corn collected 76 flies. This species was the third most abundant tachinid recorded from corn.

Voria ruralis (Fallén)

HOST: LEPIDOPTERA (Larva, pupa)
Noctuidae
Autographa californica (Speyer), alfalfa looper
Peridroma saucia (Hübner), variegated cutworm
Spodoptera frugiperda (J. E. Smith), fall armyworm
Trichoplusia ni (Hübner), cabbage looper

DISTRIBUTION: Widely distributed throughout the United States, particularly the Southwest. In Arizona, 240 specimens were collected in the lowlands, mainly in crops. This species was by far the most abundant in Rainbow Valley cotton with 1,152 specimens. In cotton at Phoenix, 536 flies were collected regularly from May through August. In traps in alfalfa, 271 flies were collected throughout the year except for April and September; May was the month of greatest abundance. In corn, 44 flies were collected in traps.

BIOLOGY: Adults are 5 to 9 mm in length with a shiny black abdomen. They mate soon after emergence and begin oviposition about 9 days later (Brubaker *1968*). Eggs are laid directly on the host larvae, and they hatch within 1 min. Females

average 311 eggs over their lifetime. The larva burrows into the host and in about 3 days cuts a hole in the dorsal wall of the abdomen and places its posterior spiracles there. The parasite develops from egg to adult in 11 days at 30°C and 19 days at 20° (Jackson et al. *1969a*). Pupation usually occurs within the host's larval skin, and the puparia are easily distinguished from those of other Tachinidae by their large protruding spiracles.

This species parasitizes second to fifth stage larvae and usually kills the host when it reaches maturity. Sometimes, flies emerge from pupae that had apparently been parasitized as mature larvae (Clancy *1969*).

Hymenoptera

Anomalon spp.

HOST: COLEOPTERA
Elateridae

DISTRIBUTION: About 200 Arizona specimens were collected mainly in lowlands; specimens were less abundant in crops. In flight traps, this was one of the more abundant hymenopterans in Rainbow Valley cotton with 52 specimens. Only seven specimens were caught in Phoenix cotton and seven in alfalfa from May to November.

Apanteles spp.

DISTRIBUTION: In Arizona, about 200 specimens were collected in lowland crop areas and a few specimens from mountains. Very few crop area species were caught even in southeastern canyons. In 1979, only three specimens were collected in Phoenix cotton and three in alfalfa. This genus, with at least 48 Arizona and California species, is poorly known taxonomically and biologically. *A. medicaginis* Muesebeck is sometimes abundant in alfalfa caterpillars.

Brachymeria coloradensis (Cresson)

HOST: ORTHOPTERA
Acrididae
DIPTERA
Sarcophagidae, parasites of acridid grasshoppers
Tachinidae, parasites of acridid grasshoppers

DISTRIBUTION: Widely distributed throughout the United States. In Arizona, about 110 specimens were collected from Cochise County to the White Mountains, mainly in crops; not collected in traps.

Brachymeria ovata (Say)

HOST: LEPIDOPTERA (Pupa)
Pieridae

Colias eurytheme Boisduval, alfalfa caterpillar
Noctuidae
Heliothis zea (Boddie); bollworm, corn earworm, tomato fruitworm
Wide range of other families and species of Lepidoptera.
DIPTERA
Tachinidae

DISTRIBUTION: Widespread throughout the United States. Arizona collections mostly reared from tent caterpillars. This was one of the more abundant parasites in 1979 traps in Rainbow Valley cotton with 59 specimens. It was also abundant in July, August, and September in Phoenix cotton with 139 wasps collected. From May to August, 28 specimens were collected in alfalfa; 26 wasps were taken in corn.

BIOLOGY: This species is a pupal parasite of a wide range of Lepidoptera (Patana et al. *1978*). The rate of development in host pupae varies somewhat depending on the species parasitized; males develop slightly faster than females. The number of days from pupal parasitism to adult male emergence ranges from 10 to 12, 11 to 14, 16 to 20 and 25 to 30 at 35°, 30°, 25°, and 20°C, respectively. For females, the number of days ranges from 10 to 11, 11 to 14, 16 to 20, and 26 to 32 days at the same temperatures.

Longevity of males ranged from 34 to 62 days at 35° and 20°C, respectively, and for females, 30 to 93 days at the same temperatures (Patana *1979*). Preoviposition periods ranged from 7 to 46 days at 35° and 20°, respectively. The mean number of progeny produced per pair ranged from 227 at 30° to 121 at 20°. At 35°, all males produced are sterile.

Bracon spp. (about eight species)

HOST: LEPIDOPTERA AND COLEOPTERA (Larva).

DISTRIBUTION: In Arizona collections, about 60 specimens were recorded from crops; not collected in traps.

Campoletis spp. (probably two species)

HOST: LEPIDOPTERA (Larva)
Noctuidae
Autographa californica (Speyer), alfalfa looper
Heliothis virescens (Fabricius), tobacco budworm
Heliothis zea (Boddie); bollworm, corn earworm, tomato fruitworm
Spodoptera exigua (Hübner), beet armyworm
Spodoptera frugiperda (J. E. Smith), fall armyworm
Spodoptera ornithogalli (Guenée), yellowstripped armyworm
Trichloplusia ni (Hübner), cabbage looper
Pieridae:
Colias eurytheme Boisduval, alfalfa caterpillar

DISTRIBUTION: About 250 specimens were taken from Arizona lowlands, a majority from crops. None were recorded from flight traps in cotton in Rainbow Valley,

but six were collected during May in Phoenix cotton. The genus occurred during February, March, April, October, November, and December in alfalfa and appears to be more active during the cooler months.

BIOLOGY: *Campoletis sonorensis* (Cameron) eggs laid in 3- to 5-day-old larvae of *H. virescens* developed to the cocoon stage in 8.1 days and to the adult stage in 14.5 days at 36°C (Nobel and Graham *1966*). The parasite prefers to attack young larvae between 2 and 4 days old. These young larvae cease feeding about 3 days later, which means that they damage crops for only 5 to 7 days compared with about 14 days for unparasitized larvae. The parasite can complete two generations for each generation of *Heliothis* spp. (Lingren et al. *1970*). The bollworm, fall armyworm, and tabacco budworm were the most preferred hosts in laboratory tests. Cabbage looper was the least preferred host; no parasites were produced in beet armyworm (Lingren and Noble *1972*).

Chelonus cautus Cresson

HOST: Unknown.

DISTRIBUTION: Texas, Arizona, and Louisiana. In Arizona, about 80 specimens were taken in crops, mainly in Pima and Cochise Counties. A few were collected at high elevations in the White Mountains. The species was recorded in flight traps in Rainbow Valley (11 specimens) and Phoenix (10 specimens) cotton and in alfalfa (7 specimens) during the midsummer months.

Chelonus insularis Cresson

HOST: LEPIDOPTERA (Larva)
Noctuidae
Heliothis zea (Boddie); bollworm, corn earworm, tomato fruitworm
Spodoptera exigua (Hübner), beet armyworm
Spodoptera frugiperda (J. E. Smith), fall armyworm
Spodoptera ornithogalli (Guenée), yellowstriped armyworm
Spodoptera praefica (Grote), western yellowstriped armyworm
Pyralidae
Loxostege sticticalis (L.), beet webworm

DISTRIBUTION: Throughout the United States. In Arizona, about 400 specimens were taken, mainly in lowland crop sweep samples plus a few at higher elevations in the White Mountains. This species was one of the more abundant parasites in cotton with 66 specimens in flight traps in Rainbow Valley and 229 in Phoenix cotton. Greatest numbers in cotton traps were observed in June. In alfalfa, about 360 wasps were taken from April through November. Only seven specimens were collected in corn.

BIOLOGY: Antennae vibrating, the female *Chelonus* approaches an armyworm egg mass. She positions her body over a single egg and raises and lowers her ovipositor several times prior to insertion. The ovipositor may remain inserted in the egg from a few seconds to one-half minute or more. Eggs may be stung as many as three times but show no sign of abnormal embryonic development. Host eggs must be in an advanced stage of embryonic development so that the parasite

egg can be deposited within the body of a larval embryo. The parasitized armyworm initially develops normally but appears emaciated and desiccated and exhibits a rough, dry integument when it attains a length of approximately one-half inch.

At this time, the armyworm makes a cell supported by a fine-meshed yellow silk cocoon, sometimes called a "death cell." About 2 days after completing the cell, the larva dies. Approximately 24 hr later, the *Chelonus* larva emerges from a hole in the middle of the shriveled body of the host (Pierce and Holloway *1912*, Luginbill *1928*, Ullyett *1949*). Time from hatching of a beet armyworm egg to the construction of the death cell varied from 37 days at 24.4°C to 8 days at 35°, whereas time from hatching of the parasitic larva to emergence of the adult *Chelonus* varied from 79 days at 24.4° to 15 days at 35° (Butler *1966b*).

Coccygomimus sanguinipes (Cresson)

HOST: LEPIDOPTERA (Prepupa and pupa)
Numerous hosts listed in Muesebeck et al. (*1951*).

DISTRIBUTION: Widespread throughout the United States. In Arizona, about 80 specimens were taken from Tucson and southeastern canyons where they were reared from the tent caterpillar.

Compsocryptus calipterus (Say)

HOST: LEPIDOPTERA (Larva, prepupa, pupa)
Concealed in tunnels of leaf rolls.

DISTRIBUTION: Semidesert areas of Colorado, New Mexico to California. In Arizona, 160 specimens were taken in lowlands, about half from crops, mainly between Tucson and Yuma. Specimens were not recorded from flight traps in Rainbow Valley cotton, but 34 were recorded at Phoenix. The species occurred from June to October with a majority of wasps collected in October. This was one of the most abundant species in alfalfa with 509 specimens collected in all months of the year. Greatest numbers were observed from October through April with peaks in November and April. It was abundant in corn, with 30 wasps collected.

Cremnops vulgaris (Cresson)

HOST: LEPIDOPTERA
Pyralidae
Loxostege commixtalis (Walker), alfalfa webworm
Loxostege sticticalis (L.), beet webworm

DISTRIBUTION: Pennsylvania to Louisiana west to Oregon and New Mexico. In Arizona, 40 specimens were collected in lowlands, about half in crops.

Diadegma insulare (Cresson)

HOST: LEPIDOPTERA
Pyralidae
Hellula rogatalis (Hulst)
Plutellidae
Plutella armoraciae Busck

DISTRIBUTION: Widespread throughout the United States. In Arizona, about 100 specimens were collected from lowland crops mostly in Pima and Cochise Counties. Only 1 specimen was taken in a flight trap in cotton, but 44 were collected from alfalfa over the winter, about half occurring in January.

Diplazon laetatorius (Cresson)

HOST: DIPTERA (Egg, larva)
Syrphidae, many species

DISTRIBUTION: Worldwide. In Arizona, about 600 wasps were taken almost exclusively on lowland crops. Butler and Dasch (*1958*) reported that this species is the most common Diplazoninae in Arizona. Specimens were examined from all counties except Navajo and Apache. *D. laetatorius* was collected in crop areas in every month with peak numbers recorded in January, April, May, and November.

The species was not very common in flight trap samples in cotton. The 20 specimens recorded from Phoenix cotton probably came from nearby alfalfa. Although specimens were collected in alfalfa in all months of the year except July, very few were observed throughout the summer. The peak population was observed in April when 880 of the total of 1,408 specimens were recorded.

BIOLOGY: *D. laetatorius* oviposits in both egg and larval stages of the host. Usually, syrphid eggs in advanced embryonic development with larval eclosion imminent are selected by ovipositing females. The parasite's egg does not hatch until the host has eclosed as a larva. Oviposition may also take place in all host larval instars, but a preference for the first and second instars has been observed. Eggs hatch in 3 to 4 days, and in late spring and summer, larval development is completed in 20 to 25 days. The parasite pupates within the host puparium. Parasitized puparia are characteristically flattened, and the glabrous surface becomes dark red (Kamal *1926*, *1939*; Kelley *1914*; Weems *1954*).

Hyposoter exiguae (Viereck)

Hyposoter pilosulus (Provancher)

HOST: LEPIDOPTERA (Larva)
Noctuidae
Heliothis zea (Boddie); bollworm, corn earworm, tomato fruitworm
Spodoptera exigua (Hübner), beet armyworm
Spodoptera praefica (Grote), western yellowstriped armyworm
Nymphalidae
Vanessa cardui (L.), painted lady

Pieridae:
Colias eurytheme Boisduval, alfalfa caterpillar

DISTRIBUTION: Arizona species are widespread in United States. In Arizona, about 20 specimens were collected from lowland crops. The genus was not recorded in flight traps but was reared from young larvae.

BIOLOGY: The host larva is attacked when it is small, and the parasite completes its development long before it matures. The larval parasite emerges from the host caterpillar and spins a cocoon for pupation. These cocoons, with the last larval skin lightly attached at one end, are often seen on the plants (Michelbacher and Essig *1938*).

***Iphiaulax* spp.**

HOST: Unknown.

DISTRIBUTION: In Arizona, about 100 specimens were collected in lowlands and southeastern canyons. No specimens were taken in flight traps.

***Lysiphlebus testaceipes* (Cresson)**

HOST: HOMOPTERA
Aphididae, many species

DISTRIBUTION: Widely distributed throughout the United States. In Arizona, 120 specimens were collected in lowlands, mainly in crops. The species was not collected in flight traps.

***Macrocentrus ancylivorus* Rowher**

HOST: LEPIDOPTERA (Larva)
Tortricidae: Olethreutinae
Cydia pomonella (L.), codling moth
Grapholitha molesta (Busck), oriental fruit moth
Other lepidopterans

DISTRIBUTION: Widespread throughout the United States. In Arizona, 120 specimens were collected from the lowlands, with a few in southeastern canyons, mainly in light traps.

***Mesostenus longicaudis* (Cresson)**

HOST: LEPIDOPTERA
Pyralidae
Loxostege sticticalis (L.), beet webworm

DISTRIBUTION: Widespread throughout the United States. In Arizona, about 35 specimens were collected from lowlands, about half in crop sweep samples. The species was not recorded from flight traps.

Meteorus leviventris (Wesmael)

HOST: LEPIDOPTERA (Larva)
Noctuidae
Agrotis orthogonia Morrison, pale western cutworm
Spodoptera frugiperda (J. E. Smith), fall armyworm
Other cutworms and armyworms
Pieridae
Colias eurytheme Boisduval, alfalfa caterpillar

DISTRIBUTION: Throughout the United States. In Arizona, about 350 specimens were collected in the lowlands with about half in crop sweep samples and some from light traps. The species is more abundant in the spring and fall. None were collected in the flight traps in Rainbow Valley cotton, but seven were recorded in Phoenix cotton in May, June, and July. From alfalfa, 36 were recorded from November through April, and a single specimen occurred in August.

BIOLOGY: The female wasp deposits as many as 21 eggs in a host cutworm. In dry soils, the host larva usually completes construction of the pupal cell before the parasite larvae emerge, but in wet soils, the parasite larvae may emerge from the sixth or, rarely, the fifth instar of the host (King and Atkinson *1928*). Cutworms attacked by this parasite were seldom noticed until after the parasites had emerged and spun their cocoons. Usually, the entire host body was consumed. A majority (88 percent) of the parasitized cutworms had completed earthen cells, and the cocoons of the parasite were clustered inside. Where the host had not completed a cell prior to death, the cocoon cluster was found on the surface of the soil or, occasionally, below the surface. In Utah, the pupal stage averaged 12 days (Snow *1925*).

Microplitis alaskensis Ashmead

HOST: LEPIDOPTERA (Larva)
Noctuidae
Autographa californica (Speyer), alfalfa looper
Trichoplusia ni (Hübner), cabbage looper

DISTRIBUTION: Alaska, Canada, and northern contiguous United States, south to Kansas. In Arizona, specimens were collected in Cochise and Navajo Counties. The species was not collected in flight traps.

BIOLOGY: The cocoons are 4.5 mm in length, ribbed; tapering strongly toward one end, less so toward the other, greenish in color; and apparently solitary (Muesebeck *1922*). The wasps were reared from cabbage looper larvae collected in cotton, alfalfa, and lettuce (Butler *1958*).

Microplitis brassicae Muesebeck

HOST: LEPIDOPTERA (Larva)
Noctuidae
Autographa californica (Speyer), alfalfa looper
Trichoplusia ni (Hübner), cabbage looper

DISTRIBUTION: Colorado, Texas, New Mexico, Arizona and California. In Arizona, specimens were reared from larvae collected from Maricopa, Pima, Cochise, and Mohave Counties.

BIOLOGY: The species was reared from cabbage loopers collected in cotton (Butler *1958*).

Microplitis croceipes (Cresson)

HOST: LEPIDOPTERA
Noctuidae
Heliothis virescens (Fabricius), tobacco budworm
Heliothis zea (Boddie); bollworm, corn earworm, tomato fruitworm

DISTRIBUTION: Widespread across the United States and throughout Arizona. In Arizona, reared from *Heliothis* spp.: nine larvae were collected from alfalfa, six from sorghum, two from cotton, and one from weeds. Most of the host collections were made in August (Butler *1958*).

BIOLOGY: Bollworms parasitized by *M. croceipes* exhibit both anatomical and behavioral abnormalities. As the parasite larva matures, the bollworm host becomes pale yellow and stops feeding. The parasite emerges shortly (12 hr) after it has undergone the final larval molt, which leaves a small black scar on the body of the host. Parasitized earworms may continue to feed for several days following emergence of the parasite but food is not swallowed. Rather, the desiccated caterpillar webs small food pieces together with loose strands of silk. An oval cocoon with several coarse longitudinal ribs, about 5 to 6 mm in length, is spun by the mature larva as soon as it emerges from the host. The cocoon rapidly toughens and changes from almost white to a dingy yellow. The adult parasite emerges by cutting a cap off the end of the cocoon (Quaintance and Brues *1905*; Winburn and Painter *1932*).

Microplitis feltiae Muesebeck

HOST: LEPIDOPTERA (Larva)
Noctuidae
Agrotis spp., *Feltia* spp., *Peridroma* spp.

DISTRIBUTION: Indiana to Alabama, west to Washington, Arizona and Texas. Abundant and widespread in Arizona in alfalfa sweep samples during almost every month in the year.

BIOLOGY: Parasite larvae emerge from the third instar of the host larva and spin brown unattached cocoons, similar to those of Apanteles spp. Parasitized larvae may be conspicuously smaller than normal. They continue to be active, occasionally for weeks, after the emergence of the parasite (Crumb *1929*).

***Netelia* spp. (about 17 Arizona species)**

HOST: LEPIDOPTERA.

DISTRIBUTION: In Arizona, about 300 specimens were collected in lowlands and a few in crop sweep samples. Many have also been taken from light traps in the spring. In flight traps, only 2 specimens were recorded in Phoenix cotton, 4 in alfalfa during April and May, and 18 in corn.

BIOLOGY: In this genus, the egg is attached to the host by a stalk. The young parasite larva enters the host after the pupal cell is constructed or cocoon is spun so that larval development mainly occurs during the host's pupal period. The adults are nocturnal or crepuscular, are often attracted to light, and have a painful sting (Muesebeck et al. *1951*).

***Ophionini* spp.**

HOST: LEPIDOPTERA (larger caterpillars)

DISTRIBUTION: In Arizona, this tribe was represented by about 200 specimens from the lowlands, mainly in light traps. The group was not recorded in crop flight traps.

***Opius* spp. (about 42 Arizona and California species)**

HOST: DIPTERA (leaf miners)

DISTRIBUTION: About 120 Arizona specimens, none were taken in flight traps.

***Pristomerus spinator* (Fabricius)**

HOSTS: LEPIDOPTERA
- Noctuidae
  - *Heliothis virescens* (Fabricius), tabacco budworm
  - *Heliothis zea* (Boddie); bollworm, corn earworm, tomato fruitworm
  - *Spodoptera frugiperda* (J. E. Smith), fall armyworm
  - *Spodoptera praefica* (Grote), western yellowstriped armyworm
- Pieridae
  - *Colias eurytheme* Boisduval, alfalfa caterpillar
- Pyralidae
  - *Elasmopalpus lignosellus* (Zeller), lesser cornstalk borer
  - *Loxostege sticticalis* (L.), beet webworm

DISTRIBUTION: In Arizona, about 180 specimens were collected in lowlands from crops; not recorded from flight traps.

Rogas spp. (about four species in crops)

HOSTS: LEPIDOPTERA
Noctuidae
Heliothis zea (Boddie); bollworm, corn earworm, tomato fruitworm
Peridroma margaritosa (Haworth)
Trichoplusia ni (Hübner), cabbage looper

DISTRIBUTION: In Arizona, about 60 specimens represent the genus as collected in lowland crop samples and light traps and at higher elevations in the White Mountains. At least one new species is represented in these collections. The genus was not recorded from crop flight traps.

Spilochalcis spp. (three species)

HOST: May be a primary or secondary parasite in a wide range of hosts.

DISTRIBUTION: In Arizona, 30 specimens were collected in lowland crops, but the genus ranges from the lowlands to the mountains. In flight traps in cotton, 17 specimens were collected in Rainbow Valley, and 5 were recorded in Phoenix cotton. The genus was recorded from alfalfa (four specimens) and from corn (three specimens).

Syrphoctonus fuscitarsus (Provancher)

HOST: DIPTERA
Syrphidae
Allograpta obliqua (Say)
Eupeodes volucris Osten Sacken
Scaeva pyrastri (L.)

DISTRIBUTION: Widespread in the United States. In Arizona, about 110 specimens were taken mostly in lowland crop sweep samples. This species is widely distributed throughout the crop areas of Arizona and is abundant in March, April, and May (Butler and Dasch *1958*). It was not recorded from cotton and corn flight traps, but 195 specimens were collected in alfalfa from October through April. Peak numbers in traps were also observed in the spring.

Temelucha spp. (about four species)

HOST: LEPIDOPTERA (larvae that conceal themselves in feeding).

DISTRIBUTION: In Arizona, about 400 specimens were collected in lowland crop samples but not in canyons or mountains. *T. platynotae* (Cushman), a parasite of *Platynota stultana* Walsingham, is the most abundant species in the collections. The genus was also recorded in flight traps in cotton in Rainbow Valley

(nine specimens) and in Phoenix (eight specimens) from August to October. In alfalfa, 11 specimens were recorded from May through November; 3 were collected in corn.

Zele mellea (Cresson)

HOST: LEPIDOPTERA
Noctuidae
Feltia subterranea (Fabricius), granulate cutworm
Spodoptera frugiperda (J. E. Smith), fall armyworm
Spodoptera ornithogalli (Guenée), western yellow striped armyworm

DISTRIBUTION: Throughout the United States. In Arizona, 60 specimens were collected in lowlands and in light traps, but only 2 in crop sweep samples. This species was the most abundant hymenopterous parasite in Rainbow Valley cotton flight traps with 88 specimens taken in June and early July. In Phoenix cotton, 21 were collected from early to midsummer. In alfalfa, a few occurred in May and June, but most of the 23 specimens occurred from October to January. In traps in corn, 27 specimens were recorded.

BIOLOGY: Duration of the pupal stage ranged from 8 to 16 days. Initially, the cocoon is white but then darkens to a pale brown with a darker band around the middle (Luginbill *1928*).

Zelomorpha arizonensis Ashmead

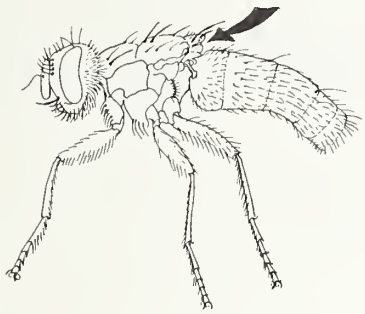
HOST: Unknown.

DISTRIBUTION: Texas, New Mexico, Arizona, and California. In Arizona, 300 specimens were collected in southeastern lowlands and canyons, many in light traps. Sixteen specimens were recorded in flight traps in Rainbow Valley cotton from June to August. Phoenix cotton yielded 11, mostly in June. In alfalfa, the species occurred sporadically with seven wasps recorded in December, February, June, and July. The species was represented in corn by a single specimen.

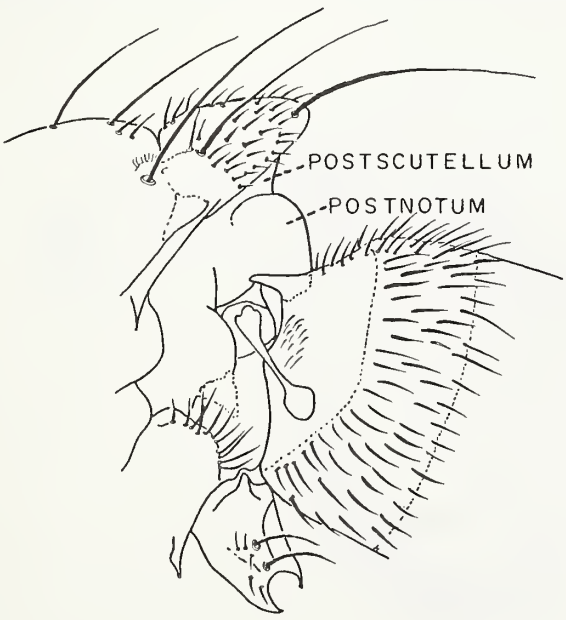
KEYS TO SPECIES

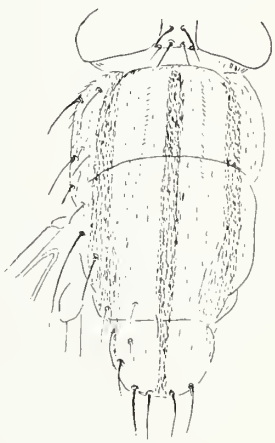
Diptera

1. Postscutellum bulging. Body form variable. If black with gray bloom markings, no dark line down middle of thorax. Tachinidae.....2

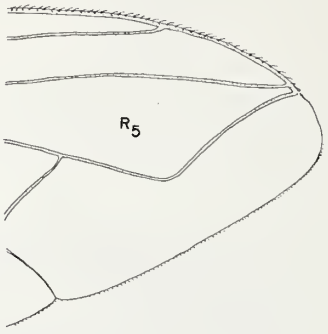


1' Postscutellum not bulging, although postnotum just behind it may be. If black with gray bloom markings, dark line present down middle of thorax. All other flies. The one shown is one sarcophagid that is often present in flight trap samples. Not treated further.

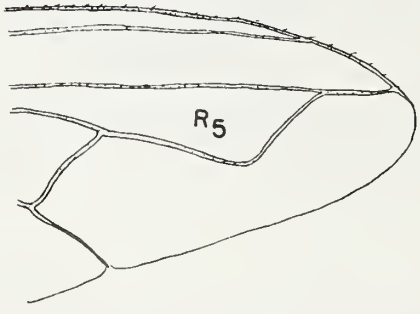




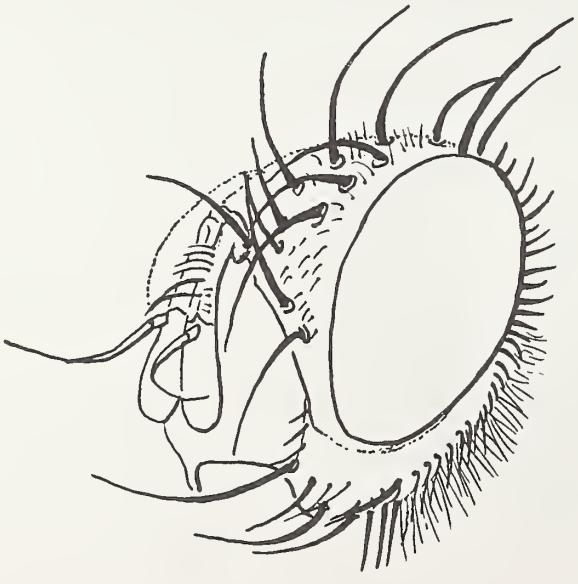
2. Cell R_5 continuing to wing margin.....3



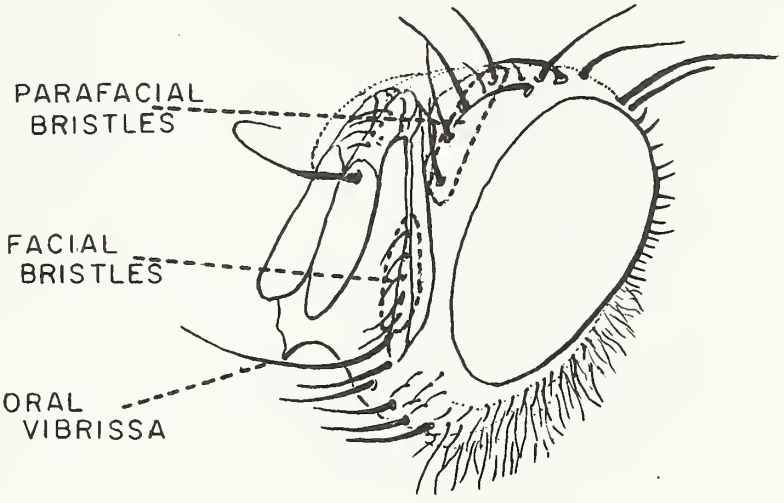
2' Cell R_5 closed before edge of wing, continuing to edge as a single vein.....29



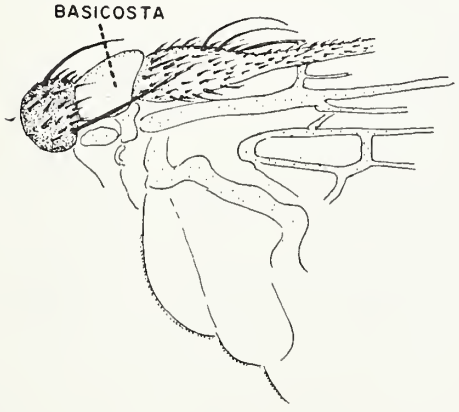
3. Body black with thin, inconspicuous gray bloom. Head bristles very strong. Antennal segment 3 paddle shaped. Facial bristles few, confined to area just above oral vibrissae. 7-10 mm. Often abundant if cabbage looper abundant. (If identification in doubt, proceed to 3' or 5).....*Voria ruralis* (Fallén)

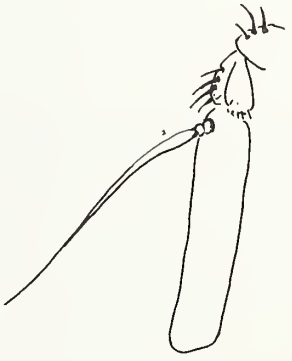


3' Body with a somewhat variegated pattern of dark and gray bloom. Facial bristles extending well up along antennal segment 3, the highest facials and lowest parafacials at same level, near base of antennal segment 3 (If facial and parafacial bristles different, proceed to 5).....4

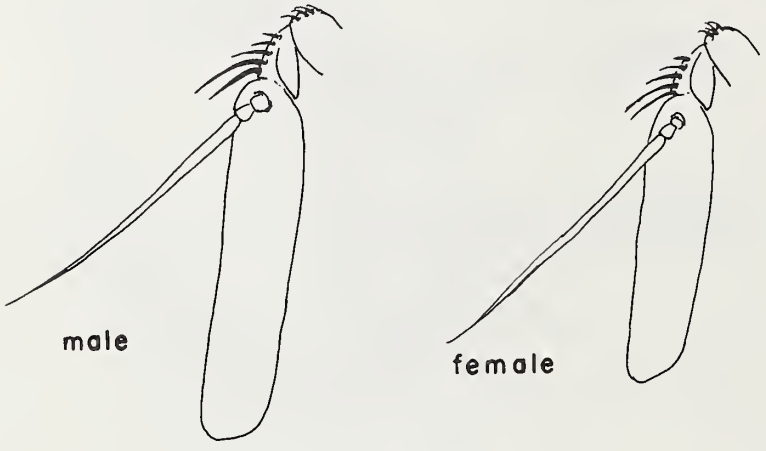


4. Basicosta pale yellowish, in sharp contrast to brown tegula. 4-7 mm, black with variegated pattern of black and gray bloom, abdomen often yellowish at sides, reddish at apex. Female with heavy, piercing larvipositor, directed forward in groove on underside of abdomen, but females rare in flight traps. Antennal segment 3 dark, moderately slender, the arista slightly longer than antennal segment 3. May be abundant in mid- and late season, if *Heliothis* abundant. (If identification in doubt, proceed to 5).....*Eucelatoria* spp.





4' Basicosta and tegula both brown. Of house fly size, 4-7 mm, black with variegated black and gray bloom, abdomen sometimes obscurely reddish on sides. Antennal segment 3 black and very long in male, reaching to oral vibrissae; reddish, especially at base, and shorter in female. Common, especially early in season. (If identification in doubt, proceed to 5).....*Lespesia archippivora* (Riley)



5 (3, 4) Facial bristles extending well up along side of antennal 3, from oral vibrissae (variable and borderline species in both sides of this couplet).....6

5' Facial bristles few, confined to area just above oral vibrissae.....15

6. Segment 2 of arista long, at least 3 times as long as segment 1 in most cases, giving arista a disjointed appearance.....7

6' Segment 2 of arista normal, short, inconspicuous, arista not disjointed, as in fig. at 4, 4'.....8

7. Basicosta black. 8-10 mm, black with gray bloom; thorax with 4 black stripes.....*Chaetogaedia monticola* (Bigot)

7' Basicosta pale. Base of antenna orange. Gray with dark-banded abdomen .....*Olenochaeta kansensis* (Townsend)

8 (6') Eyes bare (or, at most, with some obscure short setae on hind part of eye, setae as much as twice as long as the diameter of an eye facet and separated from each other by at least their length).....9

8' Eyes hairy, setae easily seen with backlighting. Most setae at least 3 times as long as an eye facet and separated from each other by no more than their length.....14

9. Basicosta pale yellow, sharply contrasting with brown tegula and costal vein. 4-7 mm, black with variegated pattern of gray bloom, abdomen often yellowish at sides, reddish at end. Female with heavy piercing larvipositor, directed anteriorly on underside of abdomen. May be abundant in mid- and late season, if *Heliothis* abundant..... .....*Eucelatoria* spp.

9' Both basicosta and tegula brown, other features variable.....10

10. Parafacial bristles extending no farther down on face than level of base of arista.....11

10' Parafacial bristles extending 1 or 2 bristles beyond level of base of arista. Large flies, rarely seen except in association with salt-marsh caterpillar.....13

11. Base of antenna at level of middle of eye; antennal segment 3 about 1/3 length of face in both sexes. Small, about 3 mm. Rare..... .....*Chaetonodexodes vanderwulpi* (Townsend)

11' Base of antenna well above middle of eye.....12

12. Of house fly size, 4-7 mm, black, with variegated gray bloom to ends of abdominal segments, abdomen sometimes obscurely reddish on sides. Antennal segment 3 black and very long in male, reddish, especially at base, and shorter in female; as in figures at 4'. Facial and parafacial bristles ending at close to same level at base of arista. Common, especially early in season ....*Lespesia archippivora* (Riley)

12' Small, about 3 mm, apical 1/3 of abdominal segments black with no bloom. Gap usually present between ends of facial and parafacial bristle rows. Rare.....*Frontiniella parancilla* Townsend

13 (10') 9-12 mm, stout, black with base of wings dusky, sides of shiny abdomen obscurly reddish, forebody with gray bloom.....*Leschenaultia adusta* (Loew)

13' 9-12 mm, black with markings of gray bloom, base of abdomen sometimes obscurely reddish at sides.....*Exorista mella* (Walker)

14(8') Cuticle of scutellum partly reddish. Antennal segment 2 pale. 7-14 mm, black with variegated gray bloom; abdomen often reddish at sides, slender and tapering in male. Frequent.....*Euphorocera tachinomoides* Townsend

14' Cuticle of scutellum black; abdomen not slender in male. Rare.....*Hyphantrophaga hyphantriae* (Townsend)

15 (5') Segment 2 of arista at least twice as long as segment 1, giving arista elbowed appearance. Basicosta pale. Large, heavy bodied flies....16

15' Segment 2 of arista normal, short, arista not elbowed.....21

16. Tegula dark brown.....17

16' Tegula pale.....18

17. Two strong bristles in clear zone between eye and oral vibrissa. No palpi. Rare.....*Deopalpus* spp.

17' No isolated bristles between eye and oral vibrissa. Palpi tiny, with 1 long bristle. Rare.....*Bonnetia comta* (Fallén)

18 (16') Parafacial area with a row of small bristles lateral to facial strip. Top of head swollen, with weak, scattered bristles. Abdomen largely yellowish. Antennal segment 3 long, slender. Segment 2 of arista very long, as long as segment 3. Rare.....*Gonia* spp.

18' Parafacial area without a row of bristles. Top of head with strong bristles. Antennal segment 3 eccentrically paddle shaped. Segment 2 of arista much shorter than segment 3.....19

19. Abdomen partly pale, with pattern of bloom. Scarce.....*Archytas marmoratus* (Townsend)

19' Abdomen black, shiny, sometimes dark reddish at sides. Head and thorax with yellowish bloom.....20

20. Area between eye and oral vibrissa with only inconspicuous pale setae. Last abdominal tergum with obscure pale bloom, especially on sides. Frequent.....*Archytas apicifer* (Walker)

20' Area between eye and antenna with some dark setae in lower portion. Rare.....*Archytas lateralis* (Macquart)

21 (15') Basicosta pale, tegula dark.....22

21' Both basicosta and tegula dark.....25

22. Thorax with 2 longitudinal black stripes. Slender, abdomen black with bands of gray bloom. Antennal segment 3 very slender.....23

22' Thorax without black stripes; other features variable.....24

23. Parafacial area with a row of strong bristles along full length of antennal segment 3. Eyes hairy. Rare..... .....*Paradidyma singularis* (Townsend)

23' Parafacial area with a few bristles, strong near oral vibrissa, weak above. Eyes bare. Usually rare.....*Ceratomyiella bicincta* Reinhard

24 (22') Parafacial bristles in a full row closer to facial strip than to eye. Antennal segment 3 long, anteriorly angulate at apex. Eyes sparsely hairy. Scarce.....*Paradidyma obliqua* Reinhard

24' Parafacial area bare below base of arista, or with only 1-2 bristles below this point. Some individuals of.....*Eucelatoria* spp.

25 (21') Eyes bare (rarely with short setae separated at base by at least their length).....26

25' Eyes hairy (setae long and separated by no more than half their length at base).....28

26. Cuticle of scutellum largely reddish. Rare.....*Drino* spp.

26' Cuticle of scutellum black.....27

27. Palpi yellow. 7-10 mm. Black with light, inconspicuous gray bloom. Head bristles very strong. Antennal segment 3 paddle shaped. Often abundant if cabbage looper abundant.....*Voria ruralis* (Fallén)

27' Palpi brown. Small, about 3 mm. Body dark, abdomen with bands of gray bloom. Rare.....*Chaetonodexodes vanderwulpi* (Townsend)

28 (25') Antennal segments 1 and 2 brown. Rare.....*Nemorilla pyste* (Walker)

28' Antennal segments 1 and 2 reddish. Rare..... .....*Hyphantrophaga hyphantriae* (Townsend)

29 (2') Abdomen a nearly solid oval shield, without bristles. 5-7 mm, thorax with black dense white bloom at front angles (female), or with golden bloom and 4 dark lines in front half (male), abdomen orange with

black markings. Frequent when stink bugs abundant.....
.....*Gymnosoma fuliginosum* Robineau-Desvoidy

29' Abdomen with normal segmentation and bristles (or sockets if bristles abraded).....30

30. Abdomen mostly orange, with black markings. 7-10 mm, abdomen long and narrow. Scarce, usually taken in spring.....*Cylindromyia* spp.

30' Abdomen mostly black, sometimes with pale bloom.....31

31. Antennal segment 3 no more than twice as long as broad.....32

31' Antennal segment 3 normal, at least 3 times as long as broad.....35

32. Eyes very large, separated by less than distance across ocelli. Female with simple ovipositor, pointed backwards.....33

32' Eyes separated by about twice distance across ocelli. Female with a pair of forceps at tip of abdomen.....34

33. Head with a single row of fine bristles between eye and base of antenna. 3-4 mm. May be very abundant in spring if false chinch bugs abundant.....*Mericia aldrichi* (Townsend)

33' Head with fine setae, in addition to a row of bristles, between eye and base of antenna. 5 mm. Not recorded in flight traps, but reared from lygus bugs.....*Alophorella aeneoventris* (Williston)

34 (32') Male abdomen all black, shiny. Female forceps together forming a pointed arch, with pointed teeth along their inner edges. 3 mm. Often moderately abundant.....*Leucostoma simplex* (Fallén)

34' Male abdomen black, with pale bloom on last 2 segments. Female forceps together forming a semicircle, with blunt teeth along their inner edges. 3.5 mm. Frequent.....*Leucostoma aterrimum* (Villers)

35 (31') No more than 2 facial bristles above oral vibrissae. Parafacial bristles in a sparse row between eye and antennal segment 3.....36

35' Numerous facial bristles extending well up alongside antennal segment 3. Parafacial bristles extending no more than 2 bristles below base of arista. 6-7 mm, gray with dark-banded abdomen. Fairly common at times.....*Olenochaeta kansensis* Townsend

36. Thorax and most of body black, shiny.....37

36' Thorax and much of rest of body with gray bloom.....38

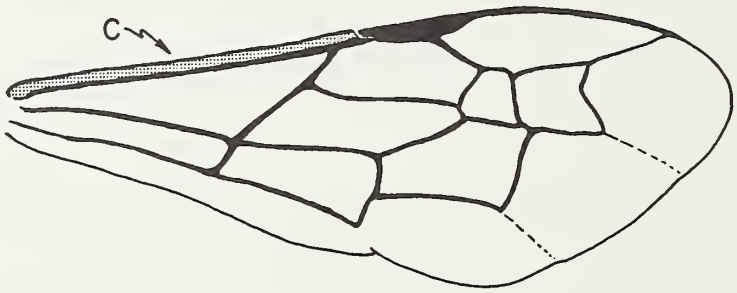
37. Wings dark along veins and crossveins. Bristles of head not arising from shiny spots. 4 mm.....*Periscepsia laevigata* (Wulp)

37' Wings unicolorous, pale. Head bristles arising from shiny spots. 4 mm, female abdomen all black, male black with bands of gray bloom.... .....*Micromintho melania* Townsend

38 (36') Thorax with 2 longitudinal dark stripes. Eyes hairy. 5 mm. Rare..... .....*Paradidyma singularis* (Townsend)

38' Thorax entirely gray. Eyes bare. Sometimes fairly abundant..... .....*Paradidyma obliqua* Reinhard

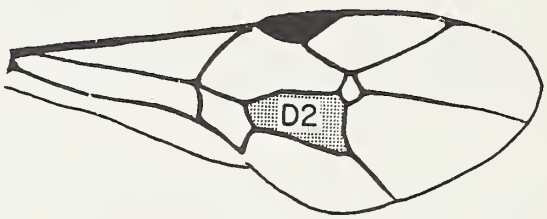
1. Front wing with a costal cell. Body form extremely variable. The wing shown is that of *Pluto*, a slender pemphredonine sphecid that can be misidentified as an ichneumonid. Antennae with no more than 13 segments. Various Hymenoptera, in many families. Not treated further.



COSTAL CELL

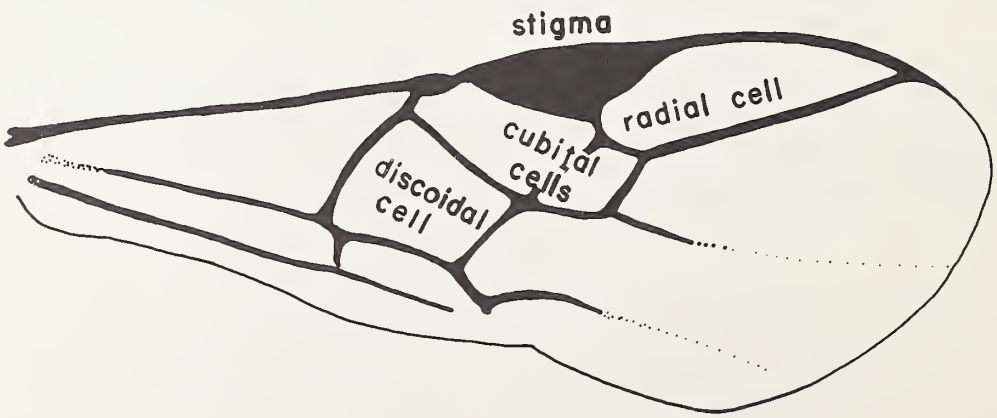
1' Front wing without a costal cell. Antennae with 16 or more segments. Wing venation almost always including at least 5 closed cells in the front wing. Superfamily Ichneumonoidea.....2

2. Front wing with a second discoidal cell, beyond middle of wing. (The first discoidal cell is lost as part of a large cell in middle of wing.) Family Ichneumonidae.....16



2ND DISCOIDAL CELL

2' Front wing without a second discoidal cell. Family Braconidae.....3



3. Upperside of abdomen a solid, convex plate, rounded at end; ovipositor arising from middle of underside.....4

3' Upperside of abdomen distinctly segmented.....5

4. Body black, abdomen black or red with an interrupted white band across base. Femora often pale. 4-5 mm. Often abundant. (=*C. texanus* Cresson).....*Chelonus insularis* Cresson

4' Smaller, black with complete white band or no band across base of abdomen. Rare.....*Chelonus* (*Microchelonus*) spp.

5 (3') Radial cell of front wing closed, as in figure at 2'.....6

5' Radial cell open.....14

6. Middle of front wing with 3 closed cells (discoidal and 2 cubitals)...7

6' Middle of front wing with only 2 closed cells, discoidal and first cubital only partly separated.....13

7. Front wing membrane pale, clear, not dusky.....8

7' Front wing membrane dusky to almost black.....12

8. Discoidal cell reaching vein at front margin of forewing.....9

8' Discoidal cell not reaching vein at front margin.....10

9. 5-10 mm, tan, subopaque, head and tip of abdomen dark in male; female with ovipositor shorter than apical height of abdomen. Common.....*Zele mellea* (Cresson)

9' 5-8 mm, tan, shiny, female with ovipositor as long as abdomen. Rare, in early season.....*Macrocentrus ancylivorus* Rohwer

10 (8') Front wing with second cubital cell broader than long. 5-6 mm. Head and thorax subopaque; abdomen shiny, segment 1 usually dark at apex, segment 2 pale, remaining segments dark; ovipositor half as long as abdomen. Sometimes fairly abundant.....*Meteorus* spp. spp.

10' Front wing with second cubital cell longer than broad; other features variable.....11

11. 2-5 mm, slender, tan to almost black, ovipositor from about 1/3 as long as abdomen to as long as body. Rare.....*Bracon* spp.

11' About 1 mm, brown, ovipositor short but visible. Sometimes abundant in sweep samples, rare in traps.....*Opius* spp.

12 (7') 4-9 mm, subopaque, reddish tan with dusky wings; ovipositor as long as apical height of abdomen. Rare.....*Rogas* spp.

12' 7-14 mm, shiny, red and black with black wings; ovipositor from half as long as abdomen to as long as body. Rare.....*Iphiaulax* spp.

13 (6') Forewing with radial cell about as long as stigma. 6-7 mm, body and legs orange and black, shiny, wings brown. Ovipositor almost as long as abdomen. Rare.....*Cremnops vulgaris* (Cresson)

13' Forewing with radial cell longer than stigma, unusually narrow. 7-8 mm, reddish brown, wings slightly dusky. Ovipositor as long as apical height of abdomen. Rare.....*Zelomorpha arizonensis* Ashmead

14 (5') Forewing without closed discoidal or cubital cells. 2 mm, shiny brown, most of legs and base of abdomen paler, contrasting; ovipositor barely visible. Rare in traps, common in sweep samples when aphids abundant.....*Lysiphlebus testaceipes* (Cresson)

14' Forewing with discoidal and at least 1 cubital cell closed. Ovipositor shorter than apical height of abdomen.....15

15. Second cubital cell closed. Rare.....*Microplitis* spp.

15' Second cubital cell not closed. Rare.....*Apanteles* spp.

Ichneumonidae

16. Spiracle of abdominal segment 1 located well behind middle of segment.. 17

16' Spiracle of abdominal segment 1 located before middle of segment.....26

17. Abdomen cylindrical in cross section, or slightly flattened from top to bottom, segments 3 and 4 wider than deep.....18

17' Abdomen flattened from side to side, segments 3 and 4 deeper than wide. 20

18. Wings yellowish with tips and 2 bands brown. Female with white band on antenna and ovipositor as long as abdomen. 10-18 mm..... .....*Compsocryptus calipterus* (Say)

18' Wings of uniform color.....19

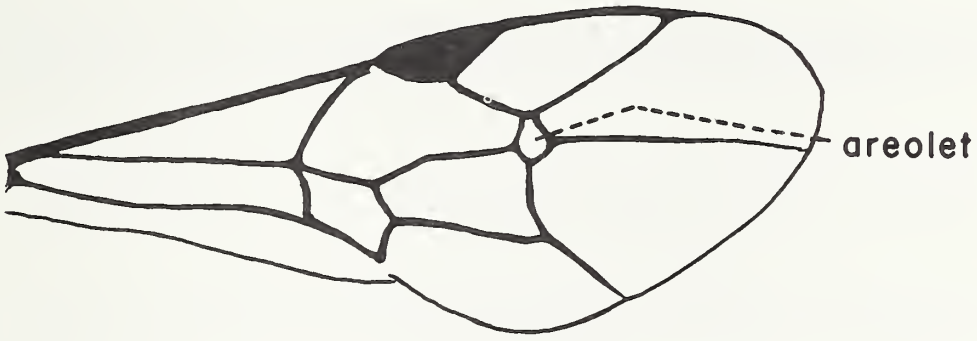
19. Female with ovipositor longer than body, white band on antenna. 7-12 mm, shiny, tan.....*Mesostenus longicaudis* (Cresson)

19' Ovipositor not visible beyond end of abdomen. Body from tan to blue-black, wings from clear to black. Several species with brown body and clear wings moderately abundant in winter and early spring (includes some Gelinae spp. males).....Ichneumoninae spp.

20 (17') Tarsal claws pectinate (with a row of long teeth). 15-30 mm, tan with large ocelli. Front wing without an areolet.....Ophioninae spp.

20' Tarsal claws not pectinate.....21

21. Front wing with an areolet. Hind tibia with base and apex black, contrasting sharply with white middle.....22



21' Front wing without an areolet. Hind tibia not so contrastingly marked 24

22. Abdominal segments dark with sides and ends pale. Legs pale. 5-7 mm., ...*Campoletis* spp.

22' Most abdominal segments all dark or all pale.....23

23. Abdominal terga all dark, or terga 2 and 3 pale on sides and end. Legs reddish. 5-6 mm.....*Diadegma insulare* (Cresson)

23' Abdominal terga mainly red, with some black on terga 1-3..... .....*Hyposoter* spp.

24 (21') Hind femur with a tooth on underside near apex. 5-9 mm, forebody from tan to black and abdomen red. Ovipositor 3 times as long as apical height of abdomen.....*Pristomerus* spp.

24' Hind femur not toothed.....25

25. Propodeum not divided into zones by ridges. Mesonotum flattened and sharply edged in front, with characteristic pale marking. 4-10 mm, tan to black.....*Anomalon* spp.

25' Propodeum divided into zones by ridges. Mesonotum not flattened nor sharply edged, all dark, or with anteromedian and lateral dark marks, ...(=*Cremastus*).....*Temelucha* spp.

26 (16') Tarsal claws pectinate. Body tan; abdomen flattened from side to side. Front wing with areolet. 12-20 mm.....*Netelia* spp.

26' Tarsal claws not pectinate. Abdomen not flattened from side to side.27

27. Wings dusky. 7-15 mm, black with red legs, including coxae.....
.....*Coccygomimus sanguinipes* (Cresson)

27' Wings clear.....28

28. Front wing without an areolet. 5-7 mm, black and white with a broad orange band on abdomen; legs orange, hind tibia with black-bordered white band.....*Diplazon laetatorius* (Fabricius)

28' Front wing with an areolet. Similar, black with a few white marks; legs orange, hind tibia with no white band.....
.....*Syrphoctonus fuscitarsus* (Provancher)

LITERATURE CITED

Andrilenas, P. A.
1974. Farmers' use of pesticides in 1971-Quantities. U.S. Department of Agriculture, Economic Research Service, Agricultural Economic Report No. 252, 56 p.

_____
1975. Farmers' use of pesticides in 1971-Extent of crop use. U.S. Department of Agriculture, Economic Research Service, Agricultural Economic Report No. 268, 25 p.

Arnaud, P. H., Jr.
1978. A host-parasite catalog of North American Tachinidae (Diptera). U.S. Department of Agriculture, Miscellaneous Publication No. 1319, 860 p.

Bariola, L. A., D. L. Kittock, J. F. Arle, and others.
1976. Controlling pink bollworms: Effects of chemical termination of cotton fruiting on populations of diapausing larvae. Journal of Economic Entomology 69:633-636.

Brubaker, R. W.
1968. Seasonal occurrence of *Voria ruralis*, a parasite of the cabbage looper, in Arizona, and its behavior and development in laboratory culture. Journal of Economic Entomology 61:306-309.

Bryan, D. E., R. E. Fye, C. G. Jackson, and R. Patana.
1973. Releases of *Bracon kirkpatricki* (Wilkinson) and *Chelonus blackburni* Cameron for pink bollworm control in Arizona. U.S. Department of Agriculture, Production Research Report No. 150, 22 p.

_____ R. E. Fye, C. G. Jackson, and R. Patana.
1976. Nonchemical control of pink bollworms. U.S. Department of Agriculture, Agricultural Research Service, Western Region, ARS-W-39, 26 p.

_____ C. G. Jackson, and R. Patana.
1968. Laboratory studies of *Lespesia archippivora* in four lepidopterous hosts. Journal of Economic Entomology 61:819-823.

_____ C. G. Jackson, and R. Patana.
1969a. Effect of temperature on the progeny production and longevity of *Lespesia archippivora* in the laboratory. Journal of Economic Entomology 62:765-767.

_____ C. G. Jackson, and R. Patana.
1969b. Rearing cotton insect parasites in the laboratory. U.S. Department of Agriculture, Production Research Report No. 109, 13 p.

_____ C. G. Jackson, and R. Patana.
1970. Biological comparison of two species of *Eucelatoria* parasitic on *Heliothis* spp. Journal of Economic Entomology 63:1469-1472.

Bryan, D. E., C. E. Jackson, E. G. Neemann, and R. Patana
1972. Production of progeny and longevity of *Eucelatoria* sp. parasitic in *Heliothis* species. Environmental Entomology 1:23-26.

Butler, G. D., Jr.
1958. Braconid wasps reared from lepidopterous larvae in Arizona, 1957. Pan-Pacific Entomologist 34:221-223.

_____
1966a. An insect flight trap for crop areas. Journal of Economic Entomology 59:1030-1031.

_____
1966b. Development of the beet armyworm and its parasite, *Chelonus texanus*, in relation to temperature. Journal of Economic Entomology 59:1324-1327.

_____ and C. E. Dasch.
1958. The Diplazoninae of Arizona. Arizona Agricultural Experiment Station, Technical Bulletin No. 135, 10 p.

_____ D. E. Byran, and C. G. Jackson.
1968. Development of the salt-marsh caterpillar parasite, *Exorista mella* at controlled constant and variable temperatures in the laboratory. Journal of Economic Entomology 61:161-162.

_____ and F. G. Werner.
1957. The syrphid flies associated with Arizona crops. Arizona Agricultural Experiment Station, Technical Bulletin No. 132, 12 p.

Carruth, L. A., and L. Moore.
1973. Cotton scouting and pesticide use in eastern Arizona. Journal of Economic Entomology 66:187-190.

Clancy, D. W.
1946. Natural enemies of some Arizona cotton insects. Journal of Economic Entomology 39:326-328.

_____
1969. Parasitization of cabbage and alfalfa loopers in southern California. Journal of Economic Entomology 62:1078-1083.

Common, I. F. B.
1958. A revision of the pink bollworm of cotton [*Pectinophora* Busck (Lepidoptera: Gelechiidae)] and related genera in Australia. Australian Journal of Zoology 6(3):268-306.

Crumb, S. E.
1929. Tobacco cutworms. U.S. Department of Agriculture, Technical Bulletin No. 88, 180 p.

Ewing, K. P., and E. F. Ivy.
1943. Some factors influencing bollworm populations and damage. Journal of Economic Entomology 36:602-606.

Fye, R. E., and C. G. Jackson.
1973. Overwintering of *Chelonus blackburni* in Arizona. Journal of Economic Entomology 66:807-808.

Gaines, J. C.
1942. Effect of boll weevil and cotton aphid control on yield as shown in a factorial experiment in 1941. Journal of Economic Entomology 35:493-495.

_____
1955a. Effect on beneficial insects of several insecticides applied for cotton insect control. Journal of Economic Entomology 47:543-544.

_____
1955b. Effect on beneficial insects of three insecticide mixtures applied for cotton insect control in 1954. Journal of Economic Entomology 48:477-478.

Jackson, C. G., G. D. Butler, Jr., and D. E. Bryan.
1969a. Time required for development of *Voria ruralis* and its host, the cabbage looper, at different temperatures. Journal of Economic Entomology 62:69-70.

_____ D. E. Bryan, and R. Patana.
1969b. Laboratory studies of *Eucelatoria armigera*, a tachinid parasite of *Heliothis* spp. Journal of Economic Entomology 62:907-910.

_____ D. E. Bryan, G. D. Butler, Jr., and R. Patana.
1970. Development, fecundity, and longevity of *Leschenaultia adusta*, a tachinid parasite of the salt-marsh caterpillar. Journal of Economic Entomology 63:1396-1397.

Kamal, M.
1926. A study of some hymenopterous parasites of aphidophagous Syrphidae. Journal of Economic Entomology 19:721-730.

_____
1939. Biological studies on some hymenopterous parasites of aphidophagous Syrphidae. Egyptian Ministry of Agriculture Technical and Scientific Service, Bulletin No. 207.

Kelly, E. O. G.
1914. Notes on the biology of *Diplazon laetatorius*. Journal of Economic Entomology 7:294-297.

King, K. M., and N. J. Atkinson.
1928. The biological control factors of the immature stages of *Euxoa ochrogaster* Gn. (Lepidoptera: Phalaenidae) in Saskatchewan. Entomological Society of America, Annals 21:167-188.

Krombein, K. V., P. D. Hurd, Jr., D. R. Smith, and B. D. Burks.
1979. Catalog of Hymenoptera in America North of Mexico. Smithsonian Institution Press, vol. 1, 1198 p.

Legner, E. F., and R. A. Medved.
1979. Influence of parasitic Hymenoptera on the regulation of pink bollworm, *Pectinophora gossypiella*, on cotton in the Lower Colorado Desert. Environmental Entomology 8:922-930.

Lingren, P. D., and L. W. Noble.
1972. Preference of *Campoletis perdistinctus* for certain noctuid larvae. Journal of Economic Entomology 65:104-107.

_____ R. T. Guerra, J. W. Nickelsen, and C. White.
1970. Hosts and host-age preference of *Campoletis perdistinctus* (Viereck). Journal of Economic Entomology 63:518-522.

Luginbill, P.
1928. The fall armyworm. U.S. Department of Agriculture, Technical Bulletin No. 34.

McGough, J. M., and L. W. Noble.
1957. Summary of work at Brownsville, Texas with imported pink bollworm parasites and an aphid predator. Journal of Economic Entomology 50:514.

Michelbacher, A. E., and E. O. Essig.
1938. Caterpillars attacking tomatoes. California Agricultural Experiment Station, Bulletin No. 625.

Muesebeck, C. F. W.
1922. A revision of the North American ichneumon-flies belonging to the subfamily Neoneurinae and Microgasterinae. U.S. National Museum, Proceedings 61(24-36):1-76.

_____ K. V. Krombein, and H. K. Townes.
1951. Hymenoptera of America North of mexico. Synoptic catalog. U.S. Department of Agriculture, Agricultural Monograph No. 2:1420.

National Academy of Science.
1975. Pest control - an assessment of present and alternative techniques. Cotton pest control, p. 4. National Academy of Science, Washington, D.C., 139 p.

Newsom, L. D., and J. R. Brazzel.
1968. Pests and their control, p. 367-405. In F. C. Elliot, M. Hoover, and W. K. Porter, Jr., editors, Advances in production and utilization of quality cotton: principles and practices. Iowa State University Press, Ames, Iowa, 532 p.

_____ and C. E. Smith
1949. Destruction of certain insect predators by applications of insecticides to control cotton pests. Journal of Economic Entomology 42:904-908.

Noble, L. W., and H. M. Graham.
1966. Behavior of *Campoletis perdistinctus* (Viereck) as a parasite of the tobbaco budworm. Journal of Economic Entomology 59:1118-1120.

Patana, R.
1979. Progeny production and longevity of individual pairs of *Brachymeria ovata* on *Heliothis virescens*. Environmental Entomology 8:987-988.

_____ C. G. Jackson, and R. E. Fye.
1978. Development of *Brachymeria ovata* in six lepidopterous hosts. Southwestern Entomologist 3:266-270.

Pierce, W. D., and T. E. Holloway.
1912. Notes on the biology of *Chelonus texanus* Cress. Journal of Economic Entomology 5:425-428.

Quaintance, A. L., and C. T. Brues.
1905. The cotton bollworm. U.S. Department of Agriculture, Bureau of Entomology, Bulletin No. 50.

Sabrosky, C. W.
1978. Tachinid parasites of *Heliothis* in the Western Hemisphere (Diptera; Lepidoptera). Entomological Society of Washington, Procedings 80:37-42.

_____
1981. A partial revision of the genus *Eucelatoria* (Diptera, Tachinidae), including important parasites of *Heliothis*. U.S. Department of Agriculture, Technical Bulletin No. 1635.

Shorey, H. H., L. K. Gaston, and R. S. Kaac.
1976. Air permeation with gossyplure for control of the pink bollworm, p. 67-74. In M. Beroza, editor, Pest management with insect sex attractants. American Chemical Society, Symposium Series No. 23, 142 p.

Snow, S. J.
1925. Observations on the cutworm, *Euxoa auxiliaris*, and its principal parasites. Journal of Economic Entomology 18:602-609.

Stone, A., C. W. Sabrosky, W. W. Wirth, and others.
1965. A catalog of the Diptera of America North of Mexico. U.S. Department of Agriculture, Agriculture Handbook No. 276, 1696 p.

Taylor, E. A.
1954. Parasitization of the salt marsh caterpillar in Arizona. Journal of Economic Entomology 47:525-530.

Telford, A. D., and L. Hopkins.
1957. Arizona cotton insects. Arizona Agricultural Experiment Station, Bulletin No. 286, 61 p.

Townsend, C. H. T.
1908. A record of results from rearings and dissections of Tachinidae. U.S. Department of Agriculture, Bureau of Entomology, Bulletin Technical Series 12:102-115.

Tuttle, D. M., G. P. Wene, and L. W. Sheets.
1961. The cotton leafperforator and its control in Arizona. Journal of Economic Entomology 54:67-70.

Ullyett, G. C.
1949. Distribution of progeny by *Chelonus texanus* Cress. (Hymenoptera:Braconidae). Canadian Emtomologist 81:25-44.

Van den Bosch, R., and K. S. Hagen.
1966. Predaceous and parasitic arthropods in California cotton fields. California Agricultural Experiment Station, Bulletin No. 820, 32 p.

_____ H. T. Reynolds, and E. J. Dietrick.
1956. Toxicity of widely used insecticides to beneficial insects in California cotton and alfalfa fields. Journal of Economic Entomology 49:359-363.

Van Steenwyck, R. A., N. C. Toscano, G. R. Bollmer, and others.
1975. Increase of *Heliothis* spp. in cotton under various insecticide treatment regimen. Environmental Entomology 4:993-996.

Walhood, V. T., T. J. Henneberry, L. A. Bariola, and others.
1981. Effects of short season water production systems in late season pink bollworm population. Journal of Economic Entomology 74:297-302.

Watson, T. F., F. M. Carasso, D. T. Langston, and others.
1978. Pink bollworm suppression through crop termination. Journal of Economic Entomology 71:638-641.

Weems, H. V., Jr.
1954. Natural enemies and insecticides that are detrimental to beneficial Syrphidae. Ohio Journal of Science 54:45-54.

Wene, G. P., and L. W. Sheets.
1962. Relationship of predatory and injurious insects in cotton fields in the Salt River Valley area of Arizona. Journal of Economic Entomology 55:395-398.

_____ L. A. Carruth, and A. D. Telford.
1965. Descriptions and habits of Arizona cotton insects. University of Arizona Cooperative Extension Service Bulletin A-23, 61 p.

Werner, F. G.
1978. Keys for the identification of parasitic insects in Arizona agricultural areas. Arizona Agricultural Experiment Station, Technical Bulletin 236, 38 p.

Werner, F. G., and G. D. Butler, Jr.
1954. Tachinid flies collected in a Phoenix, Arizona cotton field. Southwestern Entomologist 4:282-284.

Willie, J. E.
1951. Biological control of certain cotton insects and the application of new organic insecticides in Peru. Journal of Economic Entomology 44:13-18.

Wilson, A. G. L.
1972. Distribution of pink bollworm, *Pectinophora gossypiella* (Saunders) in Australia and its status as a pest in the Ord irrigation area. Journal Australian Institute of Agricultural Science 38:95-99.

Wilson, R. L., and F. D. Wilson.
1976. Nectariless and glabrous cottons: effect on pink bollworm in Arizona. Journal of Economic Entomology 69:623-624.

Winburn, T. F., and R. H. Painter.
1932. Insect enemies of the corn earworm (*Heliothis obsoleta* F.). Journal of the Kansas Entomological Society 5:4.

APPENDIX

Table 1.--*Mean number of the more common Tachinidae and parasitic Hymenoptera per trap per day collected in flight traps in pheromone treated (p) and insecticide treated (i) cottonfields, Rainbow Valley, Ariz., 1979*

		6/14-6/20	6/21-6/28	6/29-7/4	6/5-6/11	9/12-9/19	7/20-7/26	7/27-8/2	8/3-8/8	8/9-8/15	8/16-8/22	8/23-8/29	8/30-9/5	9/6-9/12	Mean total
TACHINIDAE															
Eucelatoria	p	0.10	0.02	0	0	0.03	0.40	0.60	1.00	3.10	0.50	0.10	0	0.03	5.88
	i	0	0	0	0	.30	.10	.70	3.20	3.40	1.00	.20	0	0	8.90
Euphorocera	p	.50	.03	.10	.10	.03	.30	.10	.03	.10	.01	0	.01	0	1.04
	i	.10	0	0	.10	0	0	0	0	.05	0	0	0	0	.25
Lespesia	p	.60	.20	.30	0.10	0	0	.03	.02	0	0	.03	0	.05	1.33
	i	1.30	.10	0	0	0	.10	0	.10	0	0	0	0	0	1.60
Leucostoma	p	.10	.10	.06	.03	.07	.30	.06	0	0	0.01	.01	0	0	.74
aterrimum	i	.14	0	0	0	0	0	0	.40	0	0	0	0	0	.18
L. simplex	p	1.80	.90	.30	1.30	.50	.50	.70	.50	0	.07	.10	0	0	6.67
	i	.30	1.60	.30	.30	1.00	.40	.60	.60	0	0	.10	0	0	5.20
Voria	p	0	.03	0	.03	.03	.10	.20	.30	.50	.60	.50	1.10	3.00	6.39
	i	.10	.30	0	0	.07	.60	.30	.10	.40	.20	.10	.10	0	2.27
BRACONIDAE															
Chelonus	p	0	.02	.07	.10	0	0	0	0	.03	.01	0	.04	.11	.38
	i	0	.10	.10	0	0	0	0	.05	0	.05	0	.10	0	.40

Table 2.--*Mean number of the more common Tachinidae and parasitic Hymenoptera per trap per day collected in flight traps in insecticide treated (w/) and untreated (w/o) cottonfields, University of Arizona Cotton Research Center, Phoenix, Ariz., 1979*

		5/11-5/13	5/14-5/18	5/19-6/4	6/5-6/11	6/12-6/15	6/16-6/22	6/23-6/24	6/25-6/28	6/29-7/5	7/6-7/9	7/10-7/12	7/13-7/16	7/17-7/25
TACHINIDAE														
Eucelatoria	w/	0	1.7	1.0	2.9	0.4	0.6	0.8	1.0	3.2	0	0.8	1.4	3.3
	w/o	0	0.2	0	1.1	.1	.1	.3	.1	0	0	.4	.1	0
Euphorocera	w/	0	.3	0	.1	.1	.3	2.0	8.6	1.8	1.6	2.8	1.4	.3
	w/o	.2	.6	0	0	0	0	0	0	.8	.4	.3	.4	.3

Lespesia	w/	10.7	25.5	2.0	7.6	1.9	.3	6.0	1.0	.7	1.9	1.2	3.1	1.9
	w/o	5.0	9.7	.6	3.4	1.0	.2	2.2	.6	.4	2.3	.3	.3	.2
Leucostoma	w/	0	0	0	0	0	0	0	.3	0	0	0	.1	0
aterrimum	w/o	0	.2	.3	.6	.1	.3	1.0	.1	0	0	.2	.8	0
L. simplex	w/	0	0	0	0	0	.1	.5	.1	.9	.3	.2	.5	1.3
	w/o	0	0	0	0	0	0	.8	0	0	.3	0	.3	0
Voria	w/	3.3	7.4	.1	2.0	.6	.4	3.3	4.0	2.4	.9	.8	.6	1.8
	w/o	1.0	4.9	.3	1.2	.1	.1	1.0	.4	.1	.4	0	.9	.3
BRACONIDAE														
Chelonus	w/	1.0	.9	.1	.2	0	.2	5.5	.4	.8	.4	0	0	.1
	w/o	.8	.7	0	.5	0	.6	8.3	1.5	.1	1.6	0	0	.1

		7/26-7/30	7/31-8/5	8/6-8/10	8/11 8/19	8/20-8/26	8/27-8/29	8/30 9/6	9/7-9/11	9/12 9/15	9/16 9/20	9/21-9/25	Mean total
TACHINIDAE													
Eucelatoria	w/	2.7	17.0	5.0	2.8	1.1	.2	.1	.1	0	0	.1	46.2
	w/o	.1	.3	1.1	.6	.3	.2	0	0	0	0	0	5.0
Euphorocera	w/	.3	.4	1.0	0	.2	1.0	0	0	0	0	0	22.2
	w/o	.2	.1	.2	0	.1	0	0	0	0	0	0	2.9
Lespesia	w/	.3	2.9	2.9	.8	.8	2.2	0	.7	0	0	1.6	76.0
	w/o	.6	.8	0.3	.5	.9	1.3	0	.5	.3	.2	1.4	3.3
Leucostima	w/	0	0	0	0	0	0	0	0	0	0	0	.4
aterrimum	w/o	0	0	0	0	0	.2	0	0	.3	0	.1	4.2
L. simplex	w/	.1	.3	.1	0	.1	0	0	0	0	.1	.1	4.7
	w/o	.1	0	.3	.1	0	.7	.1	0	0	.1	0	2.8
Voria	w/	.9	4.3	2.6	1.1	.7	3.0	0	0.1	0	0	0	40.3
	w/o	.2	.2	.4	.2	.1	0	0	0	0	0	0	40.3
BRACONIDAE													
Chelonus	w/o	0	.4	.2	.1	0	.2	0	.2	0	0	0	10.7
	w/	.3	.8		.1	.1	.2	.1	0	.3	.3	.1	17.0

Table 3.--*Mean number of Tachinidae and parasitic Hymenoptera per day collected in flight traps in alfalfa, Phoenix, Ariz., 1979*

	5/15-5/18	5/19-6/4	6/5-6/15	6/15-6/22	6/23-6/28	6/29-7/8	7/9-7/15	7/16-7/22	7/23-7/30	7/31-8/7	8/8-8/17	8/18-8/25	8/26-9/4	9/5-9/12	Mean total
TACHINIDAE															
Ceratomyiella	1.10	0.09	0	0	0	0.14	0.57	0.30	0.60	0.57	0.38	0.14	0.14	0.07	4.10
Chaetogaedia	3.60	.09	.07	0	.14	.20	.40	0	0	0	.06	.07	0	0	4.63
Eucelatoria	.50	.70	.79	.07	.29	0	.07	.50	.25	.50	.33	.70	.07	0	4.77
Euphorocera	3.60	0	0	0	.29	.29	.64	.25	0	.21	.06	0	0	0	5.34
Gymnosoma	0	.13	1.40	0	.29	.29	.20	.17	.19	.07	0	.14	.07	0	2.95
Lespesia	15.50	1.00	5.20	.36	2.00	2.10	2.00	.75	1.40	5.40	1.10	5.10	1.90	1.00	44.81
Paradidmya	4.4	.09	.57	0	0	.07	0	0	0	0	0	0	0	0	5.13
Periscepsia	3.4	.06	0	0	0	0	0	0	0	0	0	0	0	0	3.46
Voria	16.10	.66	.93	.07	.29	.07	.07	.25	.19	.29	0	0	.36	0	19.28
BRACONIDAE															
Chelonus	7.40	.09	.14	2.30	2.70	2.30	.86	.25	.56	1.20	.72	.34	1.0	.34	20.20
Zele	1.30	.03	.29	.07	.14	0	0	0	0	0	0	0	0	0	1.83
CHALCIDIDAE															
Brachymeria	.12	.06	.07	0	.14	0	.43	.25	.12	0	.20	.43	.21	0	2.03
ICHNEUMONIDAE															
Pristomerus	.88	0	.07	0	0	.07	0	0	.06	.07	.06	0	.07	0	1.28

Table 4.--*Mean number of Tachinidae and parasitic Hymenoptera per trap per day collected in flight traps in corn, Tempe, Ariz., 1979*

	6/3-6/9	6/17-6/23	6/24-6/30	7/1-7/7	7/8-7/14	Mean total
TACHINIDAE						
Archytas	1.0	1.6	1.2	0.4	0.2	4.4
Ceratomyiella	4.2	1.4	2.4	5.1	9.8	22.9
Chaetogaedia	.9	.2	.4	.5	.2	2.2
Eucelatoria	.5	.1	.3	0	.2	1.1
Lespesia	5.1	2.4	1.0	.5	.2	9.2
Micromintho	15.0	13.8	.2	4.0	.5	34.5
Periscepsia	10.8	1.2	.1	0	0	12.1
Voria	3.6	1.4	.5	.2	0	5.7
BRACONIDAE						
Chelonus	.4	.1	.1	0	.2	.8
Zele	.2	.8	1.2	.6	0	2.8
CHALCIDAE						
Brachymeria	2.0	.2	0	1.1	1.0	4.3
ICHNEUMONIDAE						
Compsocryptus	2.2	.2	.3	.6	1.8	5.1
Netelia	.4	1.0	.2	0	.5	2.1

LIST OF PESTICIDES MENTIONED IN THIS PUBLICATION

Pesticide description	*Chemical name*
carbaryl	1-naphthyl methylcarbamate
chlordimeform	*N'*-(4-chloro-o-tolyl)-*N*,*N*-dimethylformamidine
fenvalerate	cyano(3-phenoxyphenyl)methyl 4-chloro-α-1-α(methyl=ethyl)benzeneacetate
gossyplure	1:1 ratio of *Z*,*Z* and *Z*,*E*-isomers of 7,11-hexadecadienyl acetate
methidathion	*O*-*O*-dimethyl phosphorodithioate *S*-ester with 4-(mercaptomethyl)-2-methoxy-α2-1,3,4-thiadiazolin-5-one
permethrin	(3-phenoxyphenyl)methyl 3-(2,2-dichlorethenyl)-2,2-dimethylcyclopropane-carboxylate
TF	1-tetradecenal formate
virelure	16:1 ratio of *Z*-11-hexadecenal and *Z*-9-tetradecenal
Z9TDF	*Z*-9-tetradecen-1-ol formate

U. S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
WESTERN REGION
1333 BROADWAY, SUITE 400
OAKLAND, CALIFORNIA 94612

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
U. S. DEPARTMENT OF
AGRICULTURE
AGR 101

PRINTED MATTER

Return the mailing label(s) to above address if

- ☐ Your name or address is wrong (indicate corrections, including ZIP)
- ☐ You receive duplicate copies (include labels from all copies received)
- ☐ You do NOT wish to continue receiving this technical series